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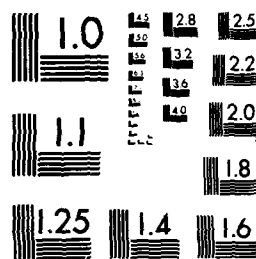
DEVELOPMENT OF A METHODOLOGY FOR ESTABLISHING JOINT
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DEFENSE

MANPOWER DATA CENTER

**Development of a Methodology
for Establishing Joint Service
Height and Weight Standards
for Enlistment**

1600 WILSON BOULEVARD ARLINGTON, VIRGINIA 22209

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<p>Recent analyses of the qualification rates for enlistment into the U.S. military have revealed differences between males and females. While 96 percent of the young males, aged 16-24 met the current height and weight standards, only 74 percent of the females, aged 16-24 were qualified for military service.</p> <p>The purpose of this report is to examine the height and weight standards currently in effect, explore the differences, and propose revisions to the height and weight standards that would mitigate the difference in the male and female qualification rates. The latter portion of the analysis involves the application of quantitative methods, consistently applied, that ensure equal treatment of males and females in the specification of proposed revised height and weight standards.</p>					
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The single constraint on the present analysis was that the maximum weight standards for young males, aged 16-24, were to remain unchanged as revisions in the height and weight standards for older males and all females were proposed. However, supplemental revisions in the maximum weight standards for the young males are presented to illustrate their effect on qualification rates in the absence of this analytic constraint.

Three data sets were used in the present analysis: the National Longitudinal Survey of Youth Labor Market Experience, and the National Health and Nutrition Examination Surveys I and II.

Also included in this report are proposed revisions of maximum and minimum weight standards as well as height standards and a summary of the effects of these proposed revisions.

The report concludes with a discussion of obesity and overweightedness, which are two distinct measures. The use of overweight as the criterion for establishing maximum weight standards, as opposed to obesity, is examined and justified.

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**Development of a Methodology
for Establishing Joint Service
Height and Weight Standards
for Enlistment**

Michael T. Laurence

**Market Research Branch
Survey and Market Analysis Division**

***Defense Manpower Data Center
1600 Wilson Boulevard, Arlington, VA 22209***

November 1985

This report has been prepared for the Directorate of Accession Policy, Office of the Deputy Assistant Secretary of Defense (Military Manpower and Personnel Policy) ((ODASD(MM&PP)(AP))). The views, opinions, findings, and conclusions are not to be construed as official Department of Defense policy, position, or decision, unless so designated by other official documentation.

PREFACE

This report was prepared at the request of Dr. W.S. Sellman, Director, and LTC Frank M. Terrell, USAF, Deputy Director, Directorate of Accession Policy, Office of the Deputy Assistant Secretary of Defense (Military Manpower and Personnel Policy) (ODASD(MM&PP)(AP)) by the Survey and Market Analysis Division of the Defense Manpower Data Center (DMDC), Zahava D. Doering, Chief.

Without the support of many people the preparation of this report would not have been possible. At DMDC, Dr. Doering provided overall direction and review. Elaine E. Sellman provided expert assistance in setting up the computer files and in reviewing the programming and data output. John A. Richards, Kyle Johnson, and Lee Giesecke reviewed the report and provided thoughtful editorial comments. Virginia L. Broadus provided invaluable support in producing the text of the report. Giovanni T. Kotoriy undertook the Herculean task of typing the tables that appear in this report. His diligence and persistence in completing this task are commendable. Connie Lyons of the DoD Office of the Actuary prepared the figures presented in the Appendix.

Capt Jeffrey D. Barnes, USAF, and Capt Denny Finkle-Cardinal, USAF, of the Directorate of Accession Policy, also performed a technical review of the report and provided insightful comments on methodological issues.

The Center for Human Resource Research at the Ohio State University, under contract to the U.S. Department of Labor, provided the data tapes

for the National Longitudinal Survey of Youth Labor Market Experience (NLS). The Department of Defense was a co-sponsor of the NLS and contributed funding to the project.

The National Center for Health Statistics (NCHS), Public Health Service, U.S. Department of Health and Human Services provided the data tapes containing the National Health and Nutrition Examination Survey I and II height and weight data that were assessed in this report. All analyses, interpretations, and conclusions that resulted from the use of these data are the responsibility of the author, and not NCHS.

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**Development of a Methodology
for Establishing Joint Service
Height and Weight Standards for Enlistment**

EXECUTIVE SUMMARY

Recent analyses of the qualification rates for enlistment into the U.S. military under the current height and weight standards published in AR 40-501, Medical Services, Standards of Physical Fitness, have revealed differences between males and females. Laurence (1984) in an analysis of data from the National Longitudinal Survey of Youth Labor Market Experience (NLS) found that while 96 percent of the young males, aged 16-24 years, met the current height and weight standards, only 74 percent of the females, aged 16-24 years, were qualified for military service. In an adaptation of the distributions of weights for males and females, aged 18-24 years, from the National Health and Nutrition Examination Survey I (NHANES I), the USAF Special Study Team (1985) estimated that the percentage of males and females who were overweight, under the AR 40-501 height and weight standards, were 4 percent and 29 percent, respectively.

The purpose of this report was to (a) examine the height and weight standards currently in effect, and explore the differences described above, and (b) propose revisions to the height and weight standards that would mitigate the difference in the male and female qualification rates. This latter portion of the analysis involved the application of

quantitative methods, consistently applied, that ensured equal treatment of males and females in the specification of proposed revised height and weight standards.

The single constraint on the present analysis was that the AR 40-501 maximum weight standards for young males, aged 16-24 years, were to remain unchanged as revisions in the height and weight standards for older males and all females were proposed. However, supplemental revisions in the maximum weight standards for the young males are presented to illustrate their effect on qualification rates in the absence of this analytic constraint.

The Data Sets

Three sets of data were used in the present analysis: the National Longitudinal Survey of Youth Labor Market Experience (NLS), the National Health and Nutrition Examination Survey I (NHANES I), and the National Health and Nutrition Examination Survey II (NHANES II). The height and weight data from the NLS Survey were self-reported. The NHANES I and NHANES II height and weight data were actual measurements.

Heights and weights for 6,091 males and 6,019 females, aged 16-24 years, from the NLS were analyzed, as were data for 1,118 males and 1,855 females from the NHANES I and 1,339 males and 1,370 females from the NHANES II. In addition, data for 1,204 males and 2,889 females from NHANES I and 1,532 males and 1,691 females from NHANES II, aged 25-40 years, were analyzed.

Explication of the Difference in Qualification Rates
Between Males and Females

Two explanations to account for the difference in qualification rates between males and females were examined. First, the possibility that when sex, age, and height are controlled for, females may indeed be more overweight than males was explored. Second, it may be that the structure of the current AR 40-501 standards themselves result in a disproportionately larger percentage of females being disqualified compared to males. Examination of the data indicated that both explanations are correct.

Data are presented which show that larger percentages of females are overweight, as defined by body weight 20 percent or more in excess of mean body weight, controlling for age, than are males. Among 16-24 year-olds, 7.3 percent of the NLS females, and 10.1 percent and 10.9 percent of the NHANES I and NHANES II females, respectively, were overweight under this criterion. The comparable percentages for 16-24 year-old males were 5.8 percent of the NLS sample, and 7.8 percent and 6.9 percent of the NHANES I and NHANES II samples, respectively.

Comparisons of mean body weights to the AR 40-501 maximum weight standards revealed that the body weights of females, as a percentage of AR 40-501 maximum weight standards were consistently higher than those for males. These differences account for most of the difference in the qualification rates between males and females.

Proposed Revision of Maximum Weight Standards

The analysis incorporated the body-mass index as an analytic tool, following the precedent established when the AR 40-501 standards for males were last revised in 1976. This index permits the evaluation of body weight independently of height and is highly correlated with the amount of body fat. Further following precedent, the standards were revised so that a single body-mass value was established for all heights within each age bracket for both males and females.

Analysis of the current weight standards for males, aged 16-24 years, revealed that the maximum allowable weights in AR 40-501 produce body-mass values that are 135 percent of the mean body-mass value. This standard was applied to the older male age brackets and all the female age brackets to establish quantitatively consistent maximum allowable weight standards for these groups. However, the result was maximum weight standards that included a moderately large percentage of individuals who were medically overweight defined as body weight 20 percent or more in excess of the mean weight.

Accordingly, the analytic constraint that the maximum weight standards for young males not be modified was eliminated, and maximum weight standards were proposed for all males and females that set the maximum allowable weight at 120 percent of mean body-mass.

Proposed Revision of Minimum Weight Standards

Analysis of the current AR 40-501 minimum required weight standards revealed that the current standards were methodologically consistent for both males and females. The current standards are 80 percent of mean body-mass of 16-20 year-olds. Accordingly, no major revision was required. However, these standards were revised so that, consistent with the maximum allowable weight standards, a single body-mass value was applied regardless of height.

Proposed Revision of Height Standards

In the absence of medical justification for different minimum and maximum height standards for males and females, the height standards were revised so that they were the same regardless of sex. The current standards of a minimum height of 60 inches for males and 58 inches for females, and a maximum height of 80 inches for males and 72 inches for females, were revised so that the minimum and maximum for both sexes was set at 58 and 80 inches, respectively.

Summary of the Effects of Proposed Revisions to AR 40-501

Presented in Table X-1 are the qualification rates of the males and females, aged 16-24 years, in each of the three data sets under current standards, under the revised height and weight standards with maximum allowable weights set at 135 percent of mean body-mass, and under the revised height and weight standards with the maximum allowable weights set at 120 percent of mean body-mass.

Table 1
Qualification Rates of Males and Females
Under Current and Revised Standards

16-24 Year-olds

		<u>Revised Standards</u>	
	<u>Current Standards</u>	<u>135% Maximum</u>	<u>120% Maximum</u>
<u>NLS</u>			
Males	95.9	96.7	92.9
Females	74.4	94.9	90.8
<u>NHANES I</u>			
Males	94.4	95.9	90.2
Females	65.4	90.9	86.3
<u>NHANES II</u>			
Males	95.3	95.7	91.7
Females	67.8	92.9	87.2

The large difference in qualification rates between males and females is reduced when either set of revised standards are applied. However, males are still qualified at a higher rate than females due to the higher incidence of overweightedness among females in the general population. Under the revised standards with the maximum allowable weight set at 135 percent of mean body-mass, the qualification rates of males is marginally higher than under current standards. Under the 120 percent of mean body-mass maximum weight standards, the qualification rate for males is moderately lower than under current standards. For females, the qualification rates under either set of revised standards are substantially higher than under the current AR 40-501 standards.

Proposed Revised AR 40-501, Appendix III, Tables of Weight

Presented in Tables X-2 and X-3 are proposed revised AR 40-501, Appendix III, Table I and Table II, respectively, which is the net result of the analysis and revision. These tables employ maximum weight standards set at 120 percent of mean body-mass, and include the revisions to the minimum required weight and height standards, as well as other minor technical changes described more fully in the report.

Concluding Discussion

The report concludes with a discussion of obesity and overweightedness, terms often used interchangeably, but which are two distinct measures. The use of overweight as the criterion for establishing maximum weight standards, as opposed to obesity, is examined and justified.

Table X-2

Proposed Revision of
AR 40-501, Appendix III, Table I
Tables of Weight, Males

APPENDIX III
TABLES OF WEIGHT

Table I. Table of Militarily Acceptable Weight (in Pounds)
as Related to Age and Height for
Males--Initial Procurement

Height (inches)	Minimum (regardless of age)	Maximum					
		16-20 yrs	21-24 yrs	25-30 yrs	31-35 yrs	36-40 yrs	41 yrs and over
58.....	84	136	141	145	150	150	150
59.....	87	141	146	151	155	155	155
60.....	90	145	151	156	161	161	161
61.....	93	150	156	161	166	166	166
62.....	96	155	161	166	172	172	172
63.....	99	160	166	172	177	177	177
64.....	102	166	171	177	183	183	183
65.....	106	171	177	183	189	189	189
66.....	109	176	182	188	195	195	195
67.....	112	181	188	194	201	201	201
68.....	116	187	194	200	207	207	207
69.....	119	192	199	206	213	213	213
70.....	122	198	205	212	219	219	219
71.....	126	204	211	218	225	225	225
72.....	130	210	217	224	232	232	232
73.....	133	216	223	231	238	238	238
74.....	137	221	229	237	245	245	245
75.....	141	228	236	244	252	252	252
76.....	144	234	242	250	258	258	258
77.....	148	240	248	257	265	265	265
78.....	152	246	255	263	272	272	272
79.....	156	252	261	270	279	279	279
80.....	160	259	268	277	286	286	286

Table X-3

Proposed Revision of
AR 40-501, Appendix III, Table II
Tables of Weight, Females

APPENDIX III
TABLES OF WEIGHT

Table II. Table of Militarily Acceptable Weight (in Pounds)
as Related to Age and Height for
Females--Initial Procurement

Height (inches)	Minimum (regardless of age)	Maximum					
		16-20 yrs	21-24 yrs	25-30 yrs	31-35 yrs	36-40 yrs	41 yrs and over
58.....	85	136	139	143	147	151	151
59.....	87	139	143	147	151	155	155
60.....	90	143	147	151	155	159	159
61.....	92	146	150	155	159	163	163
62.....	94	150	154	159	163	167	144
63.....	96	153	158	162	167	171	171
64.....	99	157	162	166	171	175	175
65.....	101	161	166	170	175	180	180
66.....	103	165	169	174	179	184	184
67.....	106	168	173	178	183	188	188
68.....	108	172	177	182	187	192	192
69.....	110	176	181	186	191	196	196
70.....	113	180	185	190	196	201	201
71.....	115	184	189	194	200	205	205
72.....	118	188	193	199	204	209	209
73.....	120	192	197	203	208	214	214
74.....	123	195	201	207	213	218	218
75.....	125	199	205	211	217	223	223
76.....	128	203	209	215	221	227	227
77.....	130	208	214	220	226	232	232
78.....	133	212	218	224	230	236	236
79.....	135	216	222	228	234	241	241
80.....	138	220	226	233	239	245	245

SECTION I

Introduction

Recent analyses of the qualification rates for enlistment into the U.S. military under the current height and weight standards published in AR 40-501, Medical Services, Standards of Physical Fitness, have revealed differences between males and females. Laurence (1984) in an analysis of data from the National Longitudinal Survey of Youth Labor Market Experience (NLS) found that while 96 percent of the young males, aged 16-24 years, met the current height and weight standards, only 74 percent of the females, aged 16-24 years, were qualified for military service. In terms of the percentage disqualified due to overweightedness, 3 percent of the males exceeded current standards compared to 22 percent of the females. In an adaptation of the distributions of weights for males and females, aged 18-24 years, from the National Health and Nutrition Examination Survey I (NHANES I), conducted by the National Center for Health Statistics in 1971-74, the USAF Special Study Team (1985) estimated that the percentage of males and females who are overweight, based on AR 40-501 height and weight standards, was 4 percent and 29 percent, respectively.

These data raise questions as to the reasons for the disparity in qualification rates of males compared to females. The purpose of this report was to (a) examine the height and weight standards currently in effect and explore the differences described above, and (b) propose revisions to the height and weight standards that would mitigate the difference in the male and female qualification rates. This latter

portion of the analysis involved the application of quantitative methods, consistently applied, that will ensure equal treatment of males and females in the specification of proposed revised height and weight standards.

The single constraint on the present analysis was that the AR 40-501 maximum weight standards for young males, aged 16-24 years, were to remain unchanged as revisions in the height and weight standards for older males and all females are proposed. However, supplemental revisions in the maximum weight standards for the young males are presented to illustrate their effect on qualification rates in the absence of this analytic constraint.

Presented in Tables 1a and 1b are the two tables that comprise Appendix III of AR 40-501 that present the militarily acceptable weight (in pounds) as related to age and height at initial procurement. These tables are incorporated into the regulation as part of Section XII, Height, Weight and Body Build, Paragraphs 2-22a and 2-22b. Paragraph 2-21b specifies the height standards for enlistment and induction. For men, the minimum acceptable height is 60 inches for enlistment and induction into the Army and Air Force, while the maximum height is 80 inches for enlistment and induction into the Army and Air Force and 78 inches for the Navy and Marine Corps. For females, the minimum acceptable height is 58 inches, and the maximum acceptable height is 72 inches for the Army. The regulation does not specify height standards for enlistment and induction of females into the Navy, Marine Corps, and Air Force.

Table 1a

AR 40-501, Appendix III, Table I
Tables of Weight, Males

1 December 1983

C 34, AR 40-501

APPENDIX III
TABLES OF WEIGHT**Table 1. Table of Militarily Acceptable Weight (in Pounds) as Related to Age and Height for Males—Initial Procurement**

Height (inches)	Minimum (regardless of age)	*MAXIMUM				
		16-20 years	21-30 years	31-35 years	36-40 years	41 years and over
60	100	158	163	162	157	150
61	102	163	168	167	162	155
62	103	168	174	173	168	160
63	104	174	180	178	173	165
64	105	179	185	184	179	171
65	106	185	191	190	184	176
66	107	191	197	196	190	182
67	111	197	203	202	196	187
68	115	203	209	208	202	193
69	119	209	215	214	208	198
70	123	215	222	220	214	204
71	127	221	228	227	220	210
72	131	227	234	233	226	216
73	135	233	241	240	233	222
74	139	240	248	246	239	228
75	143	246	254	253	246	234
76	147	253	261	260	252	241
77	151	260	268	266	259	247
78	153	267	275	273	266	254
*79	159	273	282	281	273	260
*80	166	280	289	288	279	267

* Applies only to personnel enlisted, inducted, or appointed in the Army and enlisted or inducted into the Air Force.
Does not apply to Navy or Marine Corps enlistees or inductees.

Table 1b

AR 40-501, Appendix III, Table II
Tables of Weight, Females

C 34, AR 40-501

1 December 1983

★Table II. Table of Militarily Acceptable Weight (in Pounds) as Related to Age
and Height for Females—Initial Procurement

Height (inches)	Minimum (regardless of age)	Maximum					
		18-20 yrs	21-24 yrs	25-30 yrs	31-35 yrs	36-40 yrs	41 yrs and over
58	90	120	124	126	129	132	135
59	92	122	126	128	131	134	137
60	94	124	128	130	133	136	139
61	96	127	130	132	135	139	141
62	98	128	132	134	137	140	144
63	100	132	134	136	139	143	145
64	102	135	136	139	143	145	149
65	104	138	140	144	148	150	153
66	106	141	145	148	151	154	157
67	109	145	149	152	156	158	162
68	112	150	153	156	160	162	166
69	115	154	157	161	164	167	170
70	118	158	162	165	168	171	174
71	122	162	166	169	173	175	179
72	125	167	171	174	178	181	184
73	128	171	177	179	183	186	190
74	130	175	182	185	188	191	195
75	133	179	187	190	194	196	200
76	136	184	192	196	199	202	205
77	139	188	197	201	204	207	211
78	141	192	203	206	209	213	216
79	144	196	208	211	215	218	220
80	147	201	213	216	219	223	225

★Table III. Table of Acceptable Weights for Army Aviation
(Classes 1, 1A, 2, 3) (Rescinded)

See AR 600-9, The Army Weight Control Program.

★Table IV. Table of Acceptable Weight (In Pounds) as Related to Height for Diving Duty.
(Rescinded)

See AR 600-9, The Army Weight Control Program.

In addition to the differential rates of disqualification between males and females described above, a review of Section XII and Appendix III of AR 40-501 suggests a number of other issues that ought to be addressed in this analysis. First, the height standards for males and females differ. There is no apparent medical justification for differential height requirements for short males and tall women. Further, it is not clear why the Navy and Marine Corps do not accept males between 78 and 80 inches in height, as do the Army and Air Force. Second, there are two age brackets for males under the age of 31 years (16-20 years and 21-30 years) while there are three for females (18-20 years, 21-24 years, and 25-30 years). Also, the minimum age for females is 18 years, while for males, the minimum age is 16 years. Third, the maximum allowable weight specified in the tables at each height increases in successive age brackets for females, while for males over the age of 30 years, it decreases. The rationale for this is not apparent. Data presented in the Build Study 1979 (1980) show that the average weight of males (and women) increases with age.

The sections of the report that follow describe the data sets used to examine the current AR 40-501 standards and test the effect of proposed revisions (Section II); present qualification rates of males and females under current height and weight standards (Section III); and explicates the difference in qualification rates between males and females (Section IV). The report continues with the development of proposed revised maximum weight standards (Sections V, VI, and X) and an examination and proposed revision of minimum weight standards (Section VII) and height standards (Section VIII). Finally, the results

of the examination and proposals for revision of AR 40-501 height and weight standards are summarized (Sections IX and XI) and the use of overweight as the criterion for establishing maximum weight standards is discussed (Section XII).

SECTION II

The Data Sets

Three sets of data were used in the present analysis. Each set of data was collected independently of the others and is a representative national probability sample of males and females. The three data sets are: (1) the National Longitudinal Survey of Youth Labor Market Experience (NLS), sponsored by the U.S. Department of Labor; (2) the National Health and Nutrition Examination Survey I (NHANES I); and (3) the National Health and Nutrition Examination Survey II (NHANES II). The NHANES I and NHANES II were both conducted by the National Center for Health Statistics (NCHS), Public Health Service, U.S. Department of Health and Human Services.

The NLS survey is a longitudinal survey of approximately 12,700 young males and females that focused on entry into and participation in the labor force. The participants in this survey were first interviewed in 1979, when their ages ranged from 14 to 21 years, and then reinterviewed in the spring of each subsequent year. The Department of Defense participated in the NLS survey in two respects. First, since service in the military can be considered to be a form of labor force participation, as an alternative to civilian employment, questions were included in the interview that sought to assess the interest in and attitudes towards military service as well as actual participation. Second, in 1980 the NLS survey participants were administered the Armed Services Vocational Aptitude Battery (ASVAB) to determine the aptitude of a representative sample of American youth for military service.

The sampling design of the NLS survey included a supplemental sample designed to oversample civilian black, Hispanic, and economically disadvantaged white youth. This was done to ensure that members of these groups were interviewed in sufficient numbers to permit accurate statistical estimates. As part of the administration of the ASVAB, the National Opinion Research Center (NORC) at the University of Chicago performed a review of the design, selection and implementation of the NLS sample to ensure its methodological soundness. In all respects, the review found that the NLS survey sample met the highest standards of survey research. The report prepared by NORC (Frankel and Williams, 1981) contains all the details of the survey design.

As part of the 1981 NLS interview, when the respondents ranged in age from 16-24 years, the participants were asked to report their height and weight. It is these self-reported data that are used as part of the present analysis. Table 2 presents the number of NLS participants that composed the NLS sample used in the present analysis. As can be seen, 6,091 young men, and 6,019 young women, aged 16-24 years, provided height and weight data. The assignment of respondents to race/ethnic categories used the same criteria as in the Profile of American Youth (Department of Defense, 1982). The designation "Whites" includes all non-black and non-Hispanic participants, such as Native Americans, Pacific Islanders, and persons of Asian ancestry. The Hispanic group includes the several subgroups, such as Mexican-Americans, Puerto Ricans, Cubans, etc., variously described as being of "Hispanic" origin.

Table 2

Sample Sizes of the
NLS, NHANES I, and NHANES II Data Sets

	Males				Females			
	White	Black	Hispanic	Total	White	Black	Hispanic	Total
NLS								
16-24 year-olds	4,127	1,529	355	6,091*	4,077	1,505	369	6,019*
25-40 year-olds	-	-	-	-	-	-	-	-
Total	4,127	1,529	355	6,091*	4,077	1,505	369	6,019*
NHANES I								
16-24 year-olds	851	209	58	1,118	1,338	401	116	1,855
25-40 year-olds	958	171	75	1,204	2,183	531	175	2,889
Total	1,809	380	133	2,322	3,521	932	291	4,744
NHANES II								
16-24 year-olds	1,079	172	88	1,339	1,091	193	86	1,370
25-40 year-olds	1,270	173	89	1,532	1,383	206	102	1,691
Total	2,349	345	177	2,871	2,474	399	188	3,061

*Race/ethnic subgroup sample sizes do not sum to the total due to unidentified respondents.

The NHANES I and NHANES II surveys were conducted in 1971-74 and 1976-80, respectively, as part of a related series of surveys to assess the health and nutritional status of all Americans, aged 6 months to 74 years. An integral part of these two surveys was the performance of a comprehensive physical examination, including the actual measurement of height and weight of the participants. A total of 23,808 males and females participated in the NHANES I and 20,322 people participated in the NHANES II survey. The details of the plan and operation of NHANES I and II surveys are summarized in National Center for Health Statistics (1977) and National Center for Health Statistics (1981), respectively.

Of the total NHANES I sample, 7,066 participants fell within the age range of interest to the present analysis. As shown in Table 2, 1,118 males and 1,855 females, aged 16-24 years, were included in the present analysis as well as 1,204 males and 2,889 women, aged 25-40 years. Of the total NHANES II sample, 5,932 participants fell in the age range of 16-40 years. As shown in Table 2, 1,339 males and 1,855 females, aged 16-24 years, were included in the present analysis, as well as 1,532 males and 1,691 females, aged 25-40 years. The assignment of NHANES I and NHANES II participants into race/ethnic categories shown in Table 2 are consistent with those criteria used for the MLS sample.

Throughout the entire examination of height and weight standards in this report, each analysis examines 16-24 year olds as a separate group, since it is these young people that represent the primary military manpower recruiting pool. These analyses are followed by ones that present data for 16-40 year olds.

SECTION III

Qualification Rates Under Current Standards

The first step in the examination AR 40-501 height and weight standards was to apply the current standards (shown in Tables 1a and 1b) to the NLS, NHANES I, and NHANES II samples and determine the qualification rates for each sample. Given the variation in the application of height standards by the individual services, all analyses used those standards in effect for enlistment and induction into the Army. That is, the minimum acceptable height of 60 inches for males, and 58 inches for females, are applied, while a maximum height of 80 inches for males, and 72 inches for females, are applied.

The screening procedure for determining the qualification for enlistment under the current height and weight standards involved first comparing the height of each individual to the height standards. If the individual failed to meet the minimum standard, or exceeded the maximum standard, they were determined to be not qualified and categorized as either "Underheight" or "Overheight", respectively. Only if the individual met the prescribed height standard was his or her actual body weight compared to the weight standards, for the appropriate age bracket, and their qualification on this criterion determined. Those whose weight was less than the minimum, or greater than the maximum, prescribed weights were determined to be not qualified and categorized as either "Underweight" or "Overweight", respectively.

Table 3a presents the percentage of American youth, aged 16-24

years, qualified and not qualified for enlistment under the current AR 40-501 standards for each of the three data sets. Data are presented for each race/ethnic group within each of the three data sets and for those not qualified, broken down by the reason for disqualification. Table 3b presents a similar analysis of the percentage qualified and not qualified for all males and females, aged 16-40 years, for the NHANES I NHANES II data sets. Data are not presented in Table 3b for the NLS sample since the maximum age for participation in this study at the time height and weight data were collected was 24 years.

As shown in Table 3a, 95.9 percent of the young males, aged 16-24 years, in the NLS sample were fully qualified for the enlistment under the current AR 40-501 height and weight standards, as were 94.4 percent of the males in the NHANES I sample and 95.3 percent of the males in the NHANES II sample. In contrast, only 74.4 percent of the females, ages 16-24 years in the NLS sample were fully qualified under the current AR 40-501 height and weight standards, as were 65.4 percent of the NHANES I sample and 67.8 percent of the NHANES II sample. While the percentages of qualified males are all similar in all three samples, the percentage of the NLS sample of qualified females is higher than that obtained for the females in the NHANES I and NHANES II samples.

As stated above, the data for the NLS sample are self-reported, while those for the NHANES I and NHANES II samples are actual measurements. A comparison of the frequency distributions of the heights and weights of the three samples (analysis not shown) indicated that NLS males tended to overstate their height, by about an inch, in comparison to

Table 3a
Percentage Qualified and Not Qualified
Under Current AR 40-501 Height and Weight Standards

16-24 Year-old Males and Females								
	Males				Females			
	White	Black	Hispanic	Total	White	Black	Hispanic	Total
NLS								
Qualified	95.9	96.0	95.9	95.9	76.4	63.2	70.3	74.4
Not Qualified:								
Underheight	0.1	0.1	0.0	0.1	0.3	1.6	0.8	0.5
Overheight	0.0	0.3	0.0	0.1	0.1	0.2	0.4	0.1
Underweight	1.3	1.7	1.9	1.3	3.1	2.1	6.2	3.0
Overweight	2.8	1.8	3.5	2.7	20.1	32.9	22.3	22.0
	4.1	4.0	5.4	4.1	23.6	36.8	29.7	25.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NHANES I								
Qualified	94.5	92.3	96.0	94.4	65.8	60.0	70.5	65.4
Not Qualified:								
Underheight	0.0	0.0	0.0	0.0	0.4	0.5	4.3	0.6
Overheight	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Underweight	2.1	3.5	0.0	2.1	5.6	4.0	4.4	5.3
Overweight	3.4	4.2	4.0	3.5	28.2	35.5	20.9	28.7
	5.5	7.7	4.0	5.6	34.2	40.0	29.5	34.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NHANES II								
Qualified	95.9	95.0	87.1	95.3	70.0	57.3	60.9	67.8
Not Qualified:								
Underheight	0.1	0.5	0.0	0.1	0.4	0.4	3.7	0.6
Overheight	0.0	0.0	0.0	0.0	0.2	0.3	0.0	0.2
Underweight	1.5	1.8	0.6	1.5	3.6	3.1	4.1	3.5
Overweight	2.5	2.7	12.3	3.1	25.9	38.9	31.4	27.9
	4.1	5.0	12.9	4.7	30.0	42.7	39.1	32.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

the actual recorded heights in the NHANES I and NHANES II samples. Females in the NLS sample tended to understate their weight, by a few pounds, in comparison to the actual recorded weights in the NHANES I and NHANES II samples. This error in reporting weight probably accounts for the apparent discrepancy between the female qualification rate of the NLS sample compared to the NHANES samples. Accordingly, this should be kept in mind in evaluating the results for the NLS sample and comparing them to the NHANES I and NHANES II samples.

Examination of the qualification rates of males by race/ethnic groups in Table 3a reveals small differences between the groups and between the samples. In contrast, there are large differences among the female race/ethnic groups. Among the NLS sample of females, 76.4 percent of the whites are qualified, compared to 63.2 percent of the blacks, and 70.3 percent of the Hispanics. Among the females in the NHANES I and NHANES II samples, blacks also have the lowest percentage qualified (60.0 percent and 57.3 percent, respectively). Among white females, in the NHANES I sample, 65.8 percent were qualified as were 70.0 percent in the NHANES II sample, compared to 70.5 percent and 60.9 percent, respectively, of the Hispanic females.

The reversal of the lower qualification rate of white females in the NHANES I sample, compared to Hispanics in the NLS and NHANES II samples, is due to sampling variation. Blacks and Hispanics were oversampled in NLS thus reducing the statistical error of the estimates. In contrast, the NHANES I and NHANES II surveys did not employ such oversampling techniques. Accordingly, the data for Hispanics in these

studies must be considered carefully.

The general patterns in the qualification rates found among 16-24 year-olds (Table 3a) also are evident among 16-40 year olds as shown in Table 3b. Table 3b presents data only for the two NHANES samples since 25-40 year olds were not interviewed in the NLS. The qualification rates for all males, aged 16-40 years in the NHANES I and NHANES II samples were 92.9 percent and 93.5 percent, respectively. In contrast, the qualification rate for females in the NHANES I and NHANES II samples were substantially lower at 64.5 percent and 63.9 percent, respectively.

An examination of the qualification rates for males, aged 16-40 years, by race/ethnic group reveals only small differences among the groups in the NHANES I sample. In the NHANES II sample the qualification rates of whites (94.1 percent) and blacks (91.8 percent) are not very dissimilar while the qualification rate is somewhat lower for Hispanics (87.7 percent). Among females, aged 16-40 years, the qualification rate for whites is the highest (66.7 percent in NHANES I and 66.5 percent in NHANES II), while that for the blacks is substantially lower (49.4 percent in NHANES I and 52.5 percent in NHANES II). The rather large disparity between the qualification rate of Hispanics in the NHANES I sample (63.3 percent) compared to the NHANES II sample (52.3 percent) may be attributed to sampling error.

The examination of Tables 3a and 3b indicates that the principal cause for disqualification, regardless of age, sex, or race/ethnic group is overweightedness. Table 4 summarizes the data on disqualification

Table 3b
Percentage Qualified and Not Qualified
Under Current AR 40-501 Height and Weight Standards

16-40 Year-old Males and Females								
	Males				Females			
	White	Black	Hispanic	Total	White	Black	Hispanic	Total
NHANES I								
Qualified	93.0	90.0	97.5	92.9	66.7	49.4	63.3	64.5
Not Qualified:								
Underheight	0.0	0.0	0.0	0.0	0.4	0.4	3.5	0.5
Overheight	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Underweight	1.2	2.8	0.0	1.3	3.4	3.6	2.6	3.4
Overweight	5.8	7.3	2.5	5.8	29.5	46.7	30.6	31.6
	7.0	10.0	2.5	7.1	33.3	50.6	36.7	35.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	=====	=====	=====	=====	=====	=====	=====	=====
NHANES II								
Qualified	94.1	91.8	87.7	93.5	66.5	52.5	52.3	63.9
Not Qualified:								
Underheight	0.1	0.5	0.0	0.1	0.2	0.2	5.2	0.5
Overheight	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1
Underweight	0.9	0.9	0.3	0.9	2.7	1.8	3.4	2.6
Overweight	4.9	6.9	12.1	5.5	30.6	45.3	39.1	32.9
	5.9	8.2	12.3	6.5	33.5	47.5	47.7	36.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	=====	=====	=====	=====	=====	=====	=====	=====

rates for overweightedness for each data set broken down by sex, race/ethnicity, and age. Among the males there is consistency in the rates of overweightedness between the three samples and between the three race/ethnic groups for the aggregated 16-24 year-olds and 16-40 year olds. Exceptions to this consistency appear among the 16-40 year-old Hispanics in the NHANES I data set (2.5 percent) and in the NHANES II data set (12.1 percent). Noteworthy in Table 4 is the finding that the percentage of males who are overweight in the 16-20 year-old and 21-25 year-old age brackets differ little from each other, but then increases successively in the 25-30, 31-35, and 36-40 year-old brackets.

In contrast to the relatively low disqualification rates among males for overweightedness are the very high rates among females regardless of age or race/ethnicity. Among all females, aged 16-24 years, 22.0 percent of the NLS sample, 28.7 percent of the NHANES I sample, and 27.9 percent of the NHANES II sample exceeded the AR 40-501 maximum weight standards. Among black females, 32.9 percent of the NLS sample, 35.5 percent of the NHANES I sample and 38.9 percent of the NHANES II sample were overweight. While the percentages of white and Hispanic females disqualified for overweightedness were lower than those for blacks, the percentages were still very high, falling in the range of 20.9 percent to 31.4 percent.

For all females, aged 16-40 years, the percentage overweight was 31.6 percent for the NHANES I sample and 32.9 percent for the NHANES II sample. Black females were disqualified at the highest rates (46.7 percent in the NHANES I sample and 45.3 percent in the NHANES II

Table 4
Percentage Overweight Under
Current AR 40-501 Height and Weight Standards

	Males				Females			
	White	Black	Hispanic	Total	White	Black	Hispanic	Total
<u>NLS</u>								
16-20	2.6	1.8	3.5	2.5	19.2	32.1	20.3	21.1
21-24	3.0	1.9	3.5	2.8	21.5	34.2	25.7	23.3
16-24	2.8	1.8	3.5	2.7	20.1	32.9	22.3	22.0
<u>NEANES I</u>								
16-20	3.5	3.8	1.0	3.4	26.1	32.6	22.8	26.7
21-24	3.3	4.7	7.1	3.7	31.1	39.2	18.8	31.2
16-24	3.4	4.2	4.0	3.5	28.2	35.5	20.9	28.7
25-30	6.6	10.7	1.3	6.7	30.0	48.9	37.8	32.6
31-35	7.9	3.6	0.0	7.1	27.8	54.8	49.8	32.0
36-40	9.5	19.5	1.4	9.8	34.5	67.5	34.6	38.6
Total	5.8	7.3	2.5	5.8	29.5	46.7	30.6	31.6
<u>NEANES II</u>								
16-20	2.4	2.9	16.3	3.2	26.7	34.5	33.2	28.1
21-24	2.6	2.3	7.9	2.9	24.8	44.7	29.7	27.8
16-24	2.5	2.7	12.3	3.1	25.9	38.9	31.4	27.9
25-30	4.6	6.2	8.5	4.9	33.6	48.0	41.0	35.9
31-35	7.4	10.1	2.5	7.4	34.8	54.7	69.0	37.8
36-40	9.9	21.5	23.4	11.9	33.7	54.1	34.3	36.4
Total	4.9	6.9	12.1	5.5	30.6	45.3	39.1	32.9

sample) with white and Hispanic females disqualified at rates ranging from 29.5 percent to 39.1 percent. As was the case with the males, the percentage of females categorized as overweight generally increased with age.

SECTION IV

Explication of the Difference in Qualification Rates Between Males and Females

There are two possible explanations that can account for the differences in disqualification rates for overweightedness of males and females under current AR 40-501 standards for enlistment. First, it may be that when sex, age, and height are controlled for, females may indeed be more overweight than males. Second, it may be that the structure of the standards themselves result in a disproportionately smaller percentage of females being qualified compared to males. We shall consider each of these two explanations in turn.

The common clinical definition of overweightedness is an excess of body weight relative to standards at each height. The most widely used set of standards used in clinical practice is the 1983 Metropolitan Height and Weight tables (Statistical Bulletin, Jan - June 1983) which are intended to indicate the range of weights associated with lowest mortality. Another definition of overweightedness is one that characterizes an individual whose weight is 20 percent or more in excess of the mean weight for their height as overweight (Society of Actuaries and Association of Life Insurance Medical Directors of America, 1980). While this method has shortcomings, in that it does not take into consideration the proportion of body weight that is fat, as opposed to bone, muscle, and soft tissue, it is useful in making basic judgments as to the likelihood of future morbidity and mortality.

Rates of Overweightness Among Males and Females

Table 5 presents summary data reported in the Build Study 1979 (Society of Actuaries and Association of Life Insurance Medical Directors of America, 1980), showing the percentages of males and females whose body weight was 20 percent or more in excess of the mean weight among the several million life insurance policies examined in the Build Study 1979 and the 13,645 persons, aged 18-74 years, drawn from the general population in the NHANES I survey. Except for the 15-19 year-old age bracket, a larger proportion of females compared to males had body weights 20 percent or more in excess of the mean weight. Overall, 4 percent of the males, aged 15-69, were reported to be overweight compared to 10 percent of the females. The NHANES I data reported in the Build Study 1979, and presented in Table 5, show that 11-12 percent of all males, aged 20-69 years, could be characterized as overweight compared to 15-16 percent of the females in the same age brackets.

Additional evidence of higher rates of overweightness among females, compared to males, is found in the three data sets used in this report. Table 6 presents the percentages of males and females in the NLS, NHANES I, and NHANES II data sets whose body weight was 20 percent or more in excess of the mean for the AR 40-501 age brackets (controlling for height) in total, and broken down by race/ethnic group. Among all males, aged 16-24 years, 5.8 percent of the NLS sample, 7.8 percent of the NHANES I sample, and 6.9 percent of the NHANES II sample could be considered to be overweight. These percentages are lower than those found among females. In the NLS sample, 7.3 percent of the 16-24 year-old

Table 5
Percentages of Males and Females with Weights
20 Percent or More in Excess of Mean Weight

Age	Body Build 1979		NHANES II	
	Males	Females	Males	Females
15-19 year-olds	8	6	-	-
20-29 year-olds	7	9	11	15
30-39 year-olds	5	10	11	15
40-49 year-olds	4	10	12	16
50-59 year-olds	4	10	12	16
60-69 year-olds	<u>4</u>	<u>9</u>	<u>11</u>	<u>15</u>
Total	<u>4</u>	<u>10</u>	<u>-</u>	<u>-</u>

Table 6

Percentage of Samples with Body Weight 20 percent or More
in Excess of Average Body Weight

	Males				Females			
	White	Black	Hispanic	Total	White	Black	Hispanic	Total
<u>NLS</u>								
16-20	5.4	3.8	7.5	5.2	6.8	10.6	4.4	6.5
21-24	6.8	5.2	5.5	6.6	6.8	12.9	7.9	8.6
16-24	6.0	4.3	6.8	5.8	6.8	11.5	5.7	7.3
<u>NIHANES I</u>								
16-20	8.1	6.1	5.2	7.8	9.4	15.0	2.9	9.7
21-24	7.7	6.5	10.6	7.8	9.2	21.2	7.5	10.5
16-24	8.0	6.3	7.9	7.8	9.3	17.7	5.0	10.1
25-30	8.3	12.4	8.6	8.6	12.2	22.0	28.9	14.0
31-35	8.8	3.6	7.4	8.0	12.5	30.5	16.8	14.7
36-40	5.4	19.5	1.4	6.3	15.4	29.2	7.0	16.6
Total	7.8	8.7	6.4	7.8	11.4	22.5	11.2	12.8
<u>NIHANES II</u>								
16-20	4.8	6.6	24.2	6.1	9.3	13.5	11.3	9.9
21-24	8.0	5.5	12.3	8.0	10.8	23.4	8.1	12.2
16-24	6.2	6.1	18.5	6.9	9.9	17.7	9.7	10.9
25-30	7.0	11.3	11.0	7.6	13.1	29.3	15.9	15.4
31-35	7.5	10.1	2.5	7.5	18.5	26.5	45.2	18.5
36-40	8.5	11.7	20.8	9.7	14.6	32.7	8.1	16.5
Total	7.0	8.6	14.9	7.6	13.8	24.1	15.5	14.2

females were overweight, compared to 10.1 percent of the NHANES I sample and 10.9 percent of the NHANES II sample.

Among all males, aged 16-40 years, the percentage of the NHANES I sample whose weight was 20 percent or more in excess of the mean was 7.8 percent while it was 7.6 percent among the NHANES II sample. In contrast, 12.8 percent of all females, aged 16-40 years, in the NHANES I sample and 14.2 percent of all females, aged 16-40 years, in the NHANES II sample weighed 20 percent or more in excess of the mean weight.

The comparison of the rates of overweightedness among males by race/ethnic group in Table 6 shows little variation except for the Hispanic males in the NHANES II sample. Among the females, however, there is a large difference between the rates of overweightedness for black females compared to white and Hispanic females. Among the 16-24 year-old black females in the NLS sample, 11.5 percent were overweight, compared to 6.8 percent of the white females, 5.7 percent of the Hispanic females. Among the 16-24 year old females in the NHANES I sample 17.7 percent were overweight, compared to 9.3 percent and 5.0 percent of the white and Hispanic females, respectively. In the NHANES II sample, 17.7 percent of the black females, aged 16-24 years, weighed 20 percent or more in excess of the mean weight, compared to 9.9 percent and 9.7 percent of the white and Hispanic females, respectively. Comparison of the rates of overweightedness among black women, aged 16-40 years, to those for white and Hispanic females reveal similarly large differences.

Thus, the data presented in Tables 5 and 6 support the hypothesis

that, when sex, age, and height are controlled, females are more overweight than males. This finding leads to the conclusion that some portion, but not all, of the differences in disqualification rates for overweightedness presented in Table 4 is due to sex differences. Next, we shall pursue the second hypothesis, that the maximum weight standards for males and females published in AR 40-501 were constructed in a differential manner.

Comparison of AR 40-501 Maximum Weight Standards to Mean Body Weight

The analytic explication of this hypothesis involves a comparison of the mean body weight, at each height, of the males and females in each of the three data sets to the current AR 40-501 maximum weight standard at each height. Tables 7a-1 through 7e-2 present the AR 40-501 maximum allowable weight, NLS, NHANES I and NHANES II mean weight, and the percentage of the mean body weight of the AR 40-501 maximum for each of the five age brackets. The asterisk next to the mean body weights in these tables indicates that fewer than 25 cases were included in the calculation of the mean. These values should be carefully considered since the mean may be skewed due to extreme weights among such a small subsample.

Table 7a-1 presents data for the NLS sample of 16-20 year-old males and females. Among the males, between 62 and 77 inches tall, the mean weight at each height ranges from 73 percent to 77 percent of the maximum weight permitted under the current AR 40-501. In contrast, the mean weight of females at each height, between 59 and 71 inches, ranges from

Table 7a-1
Comparison of Current AR 40-501 Maximum Weight Standards
and Mean Body Weight by Height
16-20 Year-old Males and Females
NLS Sample

Height (inches)	AR 40-501 Maximum Weight		Males		Females	
	Males	Females	Mean Body Weight	Percentage of AR 40-501	Mean Body Weight	Percentage of AR 40-501
58		120			104*	87
59		122			111	91
60	158	124	147*	93	114	92
61	163	127	127*	78	116	91
62	168	128	127	76	119	95
63	174	132	131	75	123	93
64	179	135	134	75	125	93
65	185	138	139	75	128	93
66	191	141	143	75	131	93
67	197	145	145	74	136	94
68	203	150	148	73	140	93
69	209	154	153	73	147	95
70	215	158	158	73	146	92
71	221	162	161	73	146	90
72	227	167	168	74	160*	96
73	233		172	74		
74	240		179	75		
75	246		185	75		
76	253		194	77		
77	260		199	77		
78	267		186*	70		
79	273		190*	70		
80	280		234*	84		

* Indicates 25 or fewer cases included in the calculation of the mean.

90 percent to 96 percent of the maximum weight permitted under the current AR 40-501. The data for the NHANES I and NHANES II samples of 16-20 year-olds are similar (Tables 7a-2 and 7a-3), showing that the mean weight of males, as a percentage of the AR 40-501 maximum, are consistently lower than for females.

For the 21-24 year-old males and females similar results were obtained. Among the males in the NLS sample, between 64 and 76 inches tall, the mean weight as a percentage of the AR 40-501 maximum ranges from 74 percent to 79 percent, while for females, between 59 and 70 inches tall, the range is 91 percent to 96 percent (Table 7b-1). The data for the NHANES I (Table 7b-2) and NHANES II (Table 7b-3) samples of 21-24 year-old males and females are similar to those for the NLS sample.

Among the 25-30 year-olds (Tables 7c-1 and 7c-2), 31-35 year-olds (Tables 7d-1 and 7c-2), and 36-40 year-olds (Tables 7e-1 and 7e-2) the percentage of mean weight of the AR 40-501 maximum weight is consistently lower among the males compared to the females.

In sum, these data show that the maximum weight permitted males under AR 40-501 is more liberal than the maximum weight permitted females. Returning to Table 7a-1 for an example, we see that a 67 inch tall male, between 16 and 20 years old, may weight up to 197 pounds and still be qualified for enlistment. Dividing the 145 pound mean weight of NLS males at this height by the 197 pound AR 40-501 maximum yields the percentage (74 percent) of the mean weight of males this height of the AR 40-501 maximum. The reciprocal of this percentage (1 divided by .74) yields the maximum percentage (136 percent) of mean body weight at this

Table 7a-2
Comparison of Current AR 40-501 Maximum Weight Standards
and Mean Body Weight by Height
16-20 Year-old Males and Females
NHANES I Sample

Height (inches)	AR 40-501 Maximum Weight		Males		Females	
	Males	Females	Mean Body Weight	Percentage of AR 40-501	Mean Body Weight	Percentage of AR 40-501
58		120			115*	96
59		122			112*	92
60	158	124			117	94
61	163	127			117	92
62	168	128	125*	74	120	94
63	174	132	118*	68	129	98
64	179	135	147*	82	131	97
65	185	138	124	67	128	93
66	191	141	138	73	137	97
67	197	145	149	76	129	89
68	203	150	150	74	138	92
69	209	154	152	73	158*	103
70	215	158	161	75	136*	86
71	221	162	165	75	148*	91
72	227	167	168	74	140*	84
73	233		174	75		
74	240		178*	74		
75	246		172*	70		
76	253		176*	70		
77	260		171*	66		
78	267					
79	273					
80	280					

* Indicates 25 or fewer cases included in the calculation of the mean.

Table 7a-3
Comparison of Current AR 40-501 Maximum Weight Standards
and Mean Body Weight by Height
16-20 year old Males and Females
NHANES IX Sample

Height (inches)	AR 40-501 Maximum Weight		Males		Females	
	Males	Females	Mean Body Weight	Percentage of AR 40-501	Mean Body Weight	Percentage of AR 40-501
58		120			118*	98
59		122			130*	107
60	158	124	118*	75	113*	91
61	163	127	104*	64	119	98
62	168	128	127*	76	126	98
63	174	132	132*	76	126	95
64	179	135	129*	72	131	97
65	185	138	134	72	132	96
66	191	141	139	73	134	95
67	197	145	141	72	137	94
68	203	150	146	72	142	95
69	209	154	151	72	150*	97
70	215	158	160	74	147*	93
71	221	162	158	71	155*	96
72	227	167	169	74	252*	151
73	233		167	72		
74	240		173	72		
75	246		186*	76		
76	253		201*	79		
77	260		221*	85		
78	267					
79	273					
80	280					

* Indicates 25 or fewer cases included in the calculation of the mean.

Table 7b-1
Comparison of Current AR 40-501 Maximum Weight Standards
and Mean Body Weight by Height
21-24 Year-old Males and Females
NLS Sample

Height (inches)	AR 40-501 Maximum Weight		Males		Females	
	Males	Females	Mean Body Weight	Percentage of AR 40-501	Mean Body Weight	Percentage of AR 40-501
58		124			112*	90
59		126			120	95
60	163	128	141*	87	117	91
61	168	130	146*	87	121	93
62	174	132	147	84	125	95
63	180	134	134	74	125	93
64	185	136	142	77	129	95
65	191	140	150	79	130	93
66	197	145	148	75	137	94
67	203	149	152	75	139	93
68	209	153	157	75	145	95
69	215	157	161	75	151	96
70	222	162	164	74	146	90
71	228	166	171	75	148*	89
72	234	171	176	75	156*	91
73	241		179	74		
74	248		188	76		
75	254		194	76		
76	261		206	79		
77	268		208*	78		
78	275		242*	88		
79	282		213*	76		
80	289					

* Indicates 25 or fewer cases included in the calculation of the mean.

Table 7b-2
Comparison of Current AR 40-501 Maximum Weight Standards
and Mean Body Weight by Height
21-24 Year-old Males and Females
NHANES I Sample

Height (inches)	AR 40-501 Maximum Weight		Males		Females	
	Males	Females	Mean Body Weight	Percentage of AR 40-501	Mean Body Weight	Percentage of AR 40-501
58		124				
59		126				
60	163	128			121	95
61	168	130	140*	83	125	96
62	174	132			121	92
63	180	134	122*	68	130	97
64	185	136	152*	82	131	96
65	191	140	136*	71	140	100
66	197	145	151	77	142	98
67	203	149	153	75	150	101
68	209	153	158	76	144	94
69	215	157	161	75	139*	89
70	222	162	170	77	143*	88
71	228	166	166	73	172*	104
72	234	171	182	78	175*	102
73	241		185	77		
74	248		188*	76		
75	254		193*	76		
76	261		179*	69		
77	268		214*	80		
78	275		239*	87		
79	282					
80	289					

* Indicates 25 or fewer cases included in the calculation of the mean.

Table 7b-3
Comparison of Current AR 40-501 Maximum Weight Standards
and Mean Body Weight by Height
21-24 year old Males and Females
NHANES II Sample

Height (inches)	AR 40-501 Maximum Weight		Males		Females	
	Males	Females	Mean Body Weight	Percentage of AR 40-501	Mean Body Weight	Percentage of AR 40-501
58		124			100*	81
59		126			114*	90
60	163	128			118*	92
61	168	130			123	95
62	174	132	142*	82	123	93
63	180	134	144*	80	135	101
64	185	136	142*	77	133	98
65	191	140	143*	75	139	99
66	197	145	152	77	140	97
67	203	149	155	76	149	100
68	209	153	154	74	138	90
69	215	157	167	78	148*	94
70	222	162	162	73	138*	85
71	228	166	169	74	161*	97
72	234	171	176	75	231*	135
73	241		182	76		
74	248		182*	73		
75	254		203*	80		
76	261		216*	83		
77	268					
78	275		187*			
79	282		172*			
80	289					

* Indicates 25 or fewer cases included in the calculation of the mean.

Table 7c-1
Comparison of Current AR 40-501 Maximum Weight Standards
and Mean Body Weight by Height
25-30 Year-old Males and Females
NHANES I Sample

Height (inches)	AR 40-501 Maximum Weight		Males		Females	
	Males	Females	Mean Body Weight	Percentage of AR 40-501	Mean Body Weight	Percentage of AR 40-501
58		126				
59		128				
60	163	130	122*	75	120	92
61	168	132			130	98
62	174	134	142*	82	130	97
63	180	136	150*	83	134	99
64	185	139	149*	81	138	99
65	191	144	149*	78	141	98
66	197	148	151	77	138	93
67	203	152	162	80	153	101
68	209	156	165	79	155	99
69	215	161	169	79	149	93
70	222	165	181	82	149*	90
71	228	169	171	75	151*	89
72	234	174	193	82	145*	83
73	241		191	79		
74	248		194*	78		
75	254		204*	80		
76	261		216*	83		
77	268		187*	70		
78	275		232*	84		
79	282					
80	289					

* Indicates 25 or fewer cases included in the calculation of the mean.

Table 7c-2
Comparison of Current AR 40-501 Maximum Weight Standards
and Mean Body Weight by Height
25-30 Year-old Males and Females
NHANES II Sample

Height (inches)	AR 40-501 Maximum Weight		Males		Females	
	Males	Females	Mean Body Weight	Percentage of AR 40-501	Mean Body Weight	Percentage of AR 40-501
58		126			125*	99
59		128			120*	94
60	163	130			119	92
61	168	132	126*	75	135	102
62	174	134	125*	72	135	101
63	180	136	135*	75	135	99
64	185	139	143*	77	145	104
65	191	144	158	83	138	96
66	197	148	154	78	140	95
67	203	152	165	81	152	101
68	209	156	161	77	151	97
69	215	161	169	79	147	91
70	222	165	173	78	183*	111
71	228	169	174	76	155*	92
72	234	174	190	81		
73	241		187	78		
74	248		184*	74		
75	254		200*	79		
76	261		189*	72		
77	268		187*	70		
78	275		196*	71		
79	282					
80	289					

* Indicates 25 or fewer cases included in the calculation of the mean.

Table 7d-1
Comparison of Current AR 40-501 Maximum Weight Standards
and Mean Body Weight by Height
31-35 Year-old Males and Females
NHANES I Sample

Height (inches)	AR 40-501 Maximum Weight		Males		Females	
	Males	Females	Mean Body Weight	Percentage of AR 40-501	Mean Body Weight	Percentage of AR 40-501
58		129				
59		131				
60	162	133			140	105
61	167	135			127	94
62	173	137	172*	99	136	99
63	178	139	148*	83	135	97
64	184	143	160*	87	146	102
65	190	148	157*	83	145	98
66	196	151	164*	84	152	101
67	202	156	170	84	146	94
68	208	160	167	80	161	101
69	214	164	183	86	174*	106
70	220	168	181	82	166*	99
71	227	173	186	82	129*	75
72	233	178	183	79	166*	93
73	240		203*	85		
74	246		195*	79		
75	253		202*	80		
76	260		234	90		
77	266					
78	273		272*			
79	281					
80	288		234*			

* Indicates 25 or fewer cases included in the calculation of the mean.

Table 7d-2

Comparison of Current AR 40-501 Maximum Weight Standards
and Mean Body Weight by Height

31-35 year old Males and Females

NHANES II Sample

Height (inches)	AR 40-501 Maximum Weight		Males		Females	
	Males	Females	Mean Body Weight	Percentage of AR 40-501	Mean Body Weight	Percentage of AR 40-501
58		129			128*	99
59		131			145*	112
60	162	133			127*	95
61	167	135	140*	84	140	105
62	173	137	166*	96	130	95
63	178	139			142	102
64	184	143	141*	77	143	100
65	190	148	149	78	158	107
66	196	151	156	80	150	99
67	202	156	163	81	151	97
68	208	160	173	83	165	103
69	214	164	166	78	163*	99
70	220	168	183	83	167*	99
71	227	173	186	82	191*	110
72	233	178	181	78		
73	240		200*	83		
74	246		199*	81		
75	253		204*	81		
76	260		206*	79		
77	266					
78	273					
79	281					
80	288					

* Indicates 25 or fewer cases included in the calculation of the mean.

Table 7e-1
Comparison of Current AR 40-501 Maximum Weight Standards
and Mean Body Weight by Height
35-40 Year-old Males and Females
NHANES I Sample

Height (inches)	AR 40-501 Maximum Weight		Males		Females	
	Males	Females	Mean Body Weight	Percentage of AR 40-501	Mean Body Weight	Percentage of AR 40-501
58		132				
59		134				
60	157	136	124*	80	144	106
61	162	139	180*	111	130	94
62	168	140	138*	82	139	99
63	173	143	144*	83	149	104
64	179	145	145*	81	142	98
65	184	150	156*	85	149	99
66	190	154	163*	86	162	105
67	196	158	165	84	156	99
68	202	162	176	87	166	102
69	208	167	175	84	171*	102
70	214	171	175	82	163*	95
71	220	175	184	84	146*	83
72	226	181	194	86	166*	92
73	233		201*	86		
74	239		201*	84		
75	246		242*	98		
76	252		225*	89		
77	259					
78	266					
79	273					
80	279					

* Indicates 25 or fewer cases included in the calculation of the mean.

Table 7e-2
Comparison of Current AR 40-501 Maximum Weight Standards
and Mean Body Weight by Height
35-40 year old Males and Females
NHANES II Sample

Height (inches)	AR 40-501 Maximum Weight		Males		Females	
	Males	Females	Mean Body Weight	Percentage of AR 40-501	Mean Body Weight	Percentage of AR 40-501
58		132			213*	161
59		134			143*	107
60	157	136	105*	67	131*	96
61	162	139			143	103
62	168	140	176*	105	139	99
63	173	143	134*	77	148	103
64	179	145	146*	82	145	100
65	184	150	162*	88	147	98
66	190	154	163*	86	152	99
67	196	158	161	82	155	98
68	202	162	171	85	159*	98
69	208	167	179	86	163*	98
70	214	171	189	88	166*	97
71	220	175	187	85		
72	226	181	190	84		
73	233		197*	85		
74	239		192*	80		
75	246		195*	79		
76	252		224*	89		
77	259		186*	72		
78	266					
79	273		194*	71		
80	279					

* Indicates 25 or fewer cases included in the calculation of the mean.

height permitted under AR 40-501. In contrast, the reciprocal of the percentage of mean body weight to the AR 40-501 maximum for a 67 inch tall female, between 16 and 20 years old, is 107 percent ($1/(136/145)$). Thus, the methodology employed in AR 40-501 for establishing the maximum allowable weight for males differs from that used for females. The second of the two explanations is also confirmed; the current AR 40-501 weight standards are, in fact, constructed in such a way to result in a disproportionately smaller percentage of females being qualified compared to males.

SECTION V

The Development of Proposed Revised Maximum Weight Standards

Having shown that the structure of the AR 40-501 weight standards disproportionately disqualifies females (and older males) compared to males, aged 16-24 years, we shall now develop revised maximum allowable weight standards that are uniformly constructed for both sexes and for all age brackets. This portion of the analysis involves precisely defining the methodology used to establish the current maximum weight standards for the 16-20 year-old and 21 to 24 year-old males, and then applying the same methodology to the females and older males. As noted in the Introduction, we are guided by the analytic constraint that the AR 40-501 maximum weight standards for young males, aged 16-24 years, should remain unchanged.

The Body-Mass Index

The analysis at this point introduces the use of the body-mass index as an analytic tool. The establishment of maximum allowable weights must take into consideration the height, age, and sex of the individual. However, consideration of maximum weight as a function of height, age, and sex is an extremely cumbersome task given that we are dealing with heights ranging from 58 to 80 inches, five age brackets, and the two sexes. Further, simply evaluating weight as a function of height is not a particularly good measure of the degree of overweightedness. More effective is an index that is highly correlated with the amount of body fat and is independent of height (Statistical Bulletin, Jan - Mar 1984).

An index that meets these criteria is one that is expressed by the formula $BM=W/H^2$, in which body-mass (BM) is equal to weight (W) expressed in kilograms divided by height (H) expressed in meters squared.

In a validation of the use of the body-mass index as an effective quantitative method in the analysis of weights in the NHANES I sample (National Center for Health Statistics, 1983), it was determined the formula $BM=W/H^2$ was extremely effective in predicting the mean weight of males at each height from a regression equation of weight on height. However, when the formula $BM=W/H^2$ was applied to females, it was found that the predicted mean weight of short females was overestimated, compared to calculated mean weight, while the estimated mean weight of tall females was underestimated, compared to calculated mean weight. When height in the formula as applied to females was raised to the 1.5 power, rather than the 2 power, the overestimates and underestimates of mean weight for short and tall females, respectively, disappeared resulting in predictions as accurate as those for males using the $BM = W/H^2$ formula. (For a more detailed and technical discussion of the body-mass index see the Appendix, page A-31.).

Tables 8a and 8b present the current AR 40-501 height and weight tables for males and females, respectively (see Tables 1a and 1b), converted to a body-mass standard using the formula $BM = W/H^2$. Table 8c presents the converted current standards for females using the formula $BM=W/H^{1.5}$. Although the standards for females using the formula $BM=W/H^2$ shown in Table 8b are not used in the present analysis, they are presented to illustrate an additional point regarding the differing

Table 8a

AR 40-501, Appendix III, Table I

Converted to $BM=W/H^2$

Males

Height (inches)	Minimum (regardless of age)	Maximum				
		16-20 yrs	21-30 yrs	31-35 yrs	36-40 yrs	41 yrs and over
60.....	20	31	32	32	31	29
61.....	19	31	32	32	31	29
62.....	19	31	32	32	31	29
63.....	18	31	32	32	31	29
64.....	18	31	32	32	31	29
65.....	18	31	32	32	31	29
66.....	17	31	32	32	31	29
67.....	17	31	32	32	31	29
68.....	17	31	32	32	31	29
69.....	18	31	32	32	31	29
70.....	18	31	32	32	31	29
71.....	18	31	32	32	31	29
72.....	18	31	32	32	31	29
73.....	18	31	32	32	31	29
74.....	18	31	32	32	31	29
75.....	18	31	32	32	31	29
76.....	18	31	32	32	31	29
77.....	18	31	32	32	31	29
78.....	18	31	32	32	31	29
79.....	18	31	32	32	31	29
80.....	18	31	32	32	31	29

Table 8b

AR 40-501, Appendix III, Table II

Converted to $BM=W/H^2$

Females

Height (inches)	Minimum (regardless of age)	Maximum					
		18-20 yrs	21-24 yrs	25-30 yrs	31-35 yrs	36-40 yrs	41 yrs and over
58.....	19	25	26	26	27	28	28
59.....	19	25	25	26	26	27	28
60.....	18	24	25	25	26	27	27
61.....	18	24	25	25	26	26	27
62.....	18	23	23	25	25	26	26
63.....	18	23	24	24	25	25	26
64.....	18	23	23	24	25	25	26
65.....	17	23	23	24	25	25	25
66.....	17	23	23	24	24	25	25
67.....	17	23	23	24	24	25	25
68.....	17	23	23	24	24	25	25
69.....	17	23	23	24	24	25	25
70.....	17	23	23	24	24	25	25
71.....	17	23	23	24	24	25	25
72.....	17	23	23	24	24	25	25

Table 8c
 AR 40-501, Appendix III, Table II
 Converted to $BM=W/H^{1.5}$
 Females

Height (inches)	Minimum (regardless of age)	Maximum					
		18-20 yrs	21-24 yrs	25-30 yrs	31-35 yrs	36-40 yrs	41 yrs and over
58.....	23	30	31	32	33	33	34
59.....	23	30	31	32	32	33	34
60.....	23	30	31	31	32	33	34
61.....	23	30	31	31	32	33	33
62.....	22	29	30	31	31	32	33
63.....	22	30	30	30	31	32	32
64.....	22	30	30	30	31	32	33
65.....	22	30	30	31	32	32	33
66.....	22	29	30	31	32	32	33
67.....	22	30	30	31	32	32	33
68.....	22	30	31	31	32	32	33
69.....	22	30	31	31	32	33	33
70.....	23	30	31	32	32	33	33
71.....	23	30	31	32	32	33	34
72.....	23	31	31	32	33	33	34

methodology applied to males and females.

In 1974, the Army, in concert with the other services, and in response to a request of the Office of Assistant Secretary of Defense (Manpower and Reserve Affairs) reviewed the appropriateness of the AR 40-501 height and weight standards. As part of this review, the Armed Forces Epidemiological Board provided expert consultants who recommended that a single body-mass index value be applied as the weight standard for all heights within an age bracket, and that the maximum weight in pounds at each height be derived from the index value. These recommendations were approved and resulted in adjustments to the weight standards for males in May, 1976. It is these standards which are presently in effect.

As can be seen in Table 8a, the maximum body-mass value within each age bracket is the same regardless of height. The minimum body-mass index, which applies regardless of age, however, varies among the heights. The minimum weight standards were not the subject of the 1974 review and were not revised. In contrast to the standards for males expressed by the formula $BM=W/H^2$ are those for females, presented in Table 8b using the same formula. The standards for females were not revised in 1976, and within each age bracket and for the minimum, vary among the heights, with shorter females permitted a larger body-mass than taller women.

Another anomaly in the application of the body-mass approach to establishing minimum and maximum weight standards is that the current AR 40-501 tables specify a weight in pounds that falls in the mid-range for a particular body-mass value. For example, the tables specify that a

16 year-old male, 69 inches tall, weigh no more than 209 pounds. This height and weight converts to a body-mass value of 31. The range of weights for this height and body-mass value is 207-213 pounds. The rationale for specifying a mid-range weight maximum is not apparent. Simplicity, and the rationale of the body-mass approach, suggest that the maximum weight of the body-mass value range ought to be used in specifying the maximum allowable weight in pounds. Similarly, a mid-range value for weight in pounds is used to establish the minimum required weight, rather than the minimum weight of the body-mass value range.

The precedent established in 1976 for using a single body-mass value for all heights within an age bracket to set the maximum weight permitted males will be observed here as we propose revisions to the standards. Further, this methodology will also be applied to the minimum required weights for males, and the minimum and maximum weights for females. The minimum weight of the body-mass value weight range will be used to establish the minimum required weight, and the maximum weight of the body-mass range will be used for the maximum. This is in contrast to the use of a mid-range weight of the body-mass index as currently applied in the standards for males.

The effect of these latter adjustments is shown in Tables 9a and 9b. These tables present the percentage of Americans, aged 16-24 years and aged 16-40 years, respectively, qualified and not qualified for enlistment under current AR 40-501 standards expressed in body-mass values (see Table 8a, for males, and Table 8c, for females). A comparison of Tables 9a and 9b to Tables 3a and 3b shows only minor changes in the

Table 9a
Percentage Qualified and Not Qualified
Under Current AR 40-501 Height and Weight Standards

16-24 Year-old Males and Females

	Males				Females			
	White	Black	Hispanic	Total	White	Black	Hispanic	Total
NLS								
Qualified	96.8	96.5	96.2	96.8	78.8	66.6	75.7	77.0
Not Qualified:								
Underheight	0.1	0.1	0.0	0.1	0.3	1.6	0.8	0.5
Overheight	1.0	0.3	0.0	0.1	2.1	0.2	0.4	0.1
Underweight	1.0	1.4	1.5	1.1	2.0	1.4	2.2	1.9
Overweight	2.1	1.6	2.3	2.0	18.9	30.2	21.0	20.5
	3.2	3.5	3.8	3.2	21.2	33.4	24.3	23.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NRANES I								
Qualified	96.3	93.1	96.0	95.9	70.9	62.8	77.5	70.3
Not Qualified:								
Underheight	0.0	0.0	0.0	0.0	0.4	0.5	4.3	0.6
Overheight	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Underweight	1.5	3.2	0.0	1.6	3.6	2.9	4.1	3.5
Overweight	0.3	3.7	4.0	2.5	25.2	33.8	14.1	25.6
	1.7	6.9	4.0	4.1	29.1	37.2	22.5	29.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NRANES II								
Qualified	96.5	96.9	87.1	95.9	74.8	61.2	66.9	72.5
Not Qualified:								
Underheight	0.1	0.5	0.0	0.1	0.4	0.4	3.7	0.6
Overheight	0.0	0.0	0.0	0.0	0.2	0.3	0.0	0.2
Underweight	1.2	0.3	0.6	1.0	1.8	1.6	3.2	1.8
Overweight	2.3	2.3	12.3	2.9	22.9	36.5	26.3	24.9
	3.5	3.1	12.9	4.1	25.2	38.8	33.1	27.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 9b
Percentage Qualified and Not Qualified
Under Current AR 40-501 Height and Weight Standards

16-40 Year-old Males and Females								
	Males				Females			
	White	Black	Hispanic	Total	White	Black	Hispanic	Total
NHANES I								
Qualified	94.7	90.5	97.5	94.4	70.5	52.5	67.7	69.2
Not Qualified:								
Underheight	0.0	0.0	0.0	0.0	0.4	0.4	0.5	0.5
Overheight	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Underweight	1.0	0.5	0.0	1.1	0.3	0.5	0.3	0.3
Overweight	4.4	7.0	0.5	4.5	26.9	44.7	26.5	29.0
	5.3	9.5	0.5	5.6	29.5	47.5	27.3	31.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NHANES II								
Qualified	95.0	95.0	95.0	94.8	70.0	55.0	64.9	67.7
Not Qualified:								
Underheight	0.1	0.5	0.0	0.1	0.2	0.2	0.2	0.5
Overheight	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1
Underweight	1.6	1.2	0.2	1.5	1.4	1.1	0.0	1.5
Overweight	4.1	4.4	11.6	4.6	27.9	43.0	26.9	30.2
	4.8	5.0	11.9	5.0	29.5	45.0	27.1	32.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

qualification rates.

Among the NLS sample of young males, aged 16-24 years, conversion to body-mass resulted in a 1.1 percentage point increase in the percentage qualified while among the NLS females, aged 16-24 years, a 2.5 percentage point increase resulted. Among the NHANES I samples of 16-24 year olds the conversion resulted in an 1.5 percentage point increase in the percentage of qualified males and a 4.9 percentage point increase in the percentage of qualified females. Among the NHANES II samples of 16-24 year-old males and females, the percentage point increases are .6 and 4.7, respectively. Among the 16-40 year old NHANES I and NHANES II samples of males and females (Table 9b) similar percentage point increases occur, with the increase for females being larger than those for males.

Proposed Revised Maximum Weight Standards

To establish the appropriate maximum body-mass index value for males older than 24 years, and thus adjust the current standards to reflect that the weight of males increases with age, and to establish standards for females, in all the age brackets, using the same methodology as that applied to males, we first determined the mean body-mass for participants in each of the three data sets, in each of the five age brackets. Then, using 16-20 year-old and 21-24 year-old males as the reference group, and working backwards, we determined the percentage the current standard exceeded the mean body-mass. This percentage added to 100 and applied to the mean body-mass for the age bracket yields the maximum allowable body-mass at all heights for each of the two age

brackets. This percentage was then applied to the mean body-mass of the males in the older age brackets and the mean body-mass of the females in each age bracket.

Table 10 presents the results of these calculations and shows the change in body-mass maximums for males and females in each of the data sets. For the males, the calculations yielded the same mean body-mass value, regardless of data set, in each age bracket. These data also confirm that weight, as measured by body-mass, increases with age. Among females, there was minor variation among the three data sets in the mean body-mass value in each age bracket. Among 16-20 year-old females, the NLS and NHANES II samples yielded a mean body-mass of 28 while the mean body-mass value of the NHANES I sample was 29. Among the 21-24 year-old females, a body-mass value of 29 was the mean for the NHANES I and NHANES II samples, while the mean body-mass value was 28 for the NLS sample. Among the NHANES I 31-35 year-old females, the mean body-mass value was 32, while for the comparable group of NHANES II females it was 31. For the 25-30 year-old and 36-40 year-old females the mean body-mass value was the same for both the NHANES I and NHANES II samples, 30 and 32, respectively.

Presented beneath the mean body-mass data in Table 10 are proposed revised standards that were determined using the calculation described above. For males, aged 16-20 years and 21-24 years, the current standards, expressed in body-mass values of 31 and 32, respectively are both 135 percent of the mean body-mass values. Accordingly, this percentage was applied to the mean body-mass values to yield the maximum allowable body-mass values for the older males and for the females in each

Table 10

Summary of Body-mass Values:
Current Maximum Weight Standards, Mean Body-mass
135 Percent of Mean Body-mass, and Changes in Standards

	Males (BM $\times 10^2$)					Females (BM $\times 10^2$)				
	16-20 years	21-24 years	25-30 years	31-35 years	36-40 years	16-20 years	21-24 years	25-30 years	31-35 years	36-40 years
Current Standards	31	32	34	37	31	29-31	30-31	30-32	31-33	32-33
Mean Body-mass										
NLS	22	24	27	29	26	28	28	30	32	32
HAVER	23	25	28	30	27	29	29	30	31	32
HAVER	24	26	29	31	28	29	29	30	31	32
135% of Mean Body-mass										
NLS	31	34	37	40	35	39	39	41	43	43
HAVER	32	35	38	41	36	40	40	41	42	43
HAVER	33	36	39	42	37	41	41	41	42	43
Change: Current Standards vs. 135% of Mean Body-mass										
NLS						+7/+9	+7/+8			
HAVER					+4	+8/+10	+8/+9	+9/+11	+10/+12	+10/+11
HAVER					+4	+7/+9	+8/+9	+9/+11	+9/+11	+10/+11

age bracket. (An examination of Tables 7a-1 through 7b-3, which present comparisons of AR 40-501 standards, expressed in pounds, to the mean weight at each height, shows that the reciprocal of the mean weight at each height as a percentage of the current AR 40-501 standards ranges between 130 percent and 137 percent (excluding those heights containing less than 25 cases) for 16-20 year-old males (Table 7a-1 through 7a-3) and between 127 percent and 135 percent for 21 to 24 year-old males (Tables 7b-1 through 7b-3). Thus, the calculation used here, and the determination of the applicable percentage to be applied to the mean body-mass to set the maximum allowable body-mass value is confirmed by an alternative method.)

The effect of this methodology, in terms of changes in the body-mass value to be used as the maximum allowable weight are shown in the bottom rows of Table 10. For the males, aged 16-20 years and 21-24 years, there is no change, while for the older males the increment is larger for each successive age bracket. In contrast, the increments for the females are much larger than those for the older males due to the fact that the current standards are set so low.

The last consideration was to decide which of the three sets of maximum standards, at the 135 percent of mean body-mass levels to propose as the revised maximums. Since the NLS sample did not include males and females over the age of 25 years, it was immediately excluded from consideration leaving either the NHANES I or NHANES II data sets. The NHANES II data were selected for two reasons. First, they were collected more recently, and thus better reflect any changes in mean body weight that may have

occurred between the two surveys, and second, the standards produced for the females are slightly more conservative than those obtained from the MANES I sample.

SECTION VI

Qualification Rates Under Proposed Revised Maximum Weight Standards

Presented in Table III are comparisons of the percentages of 16-24 year old males and females qualified for military service under current AR 40-561 standards, expressed in terms of body-mass, and under the maximum weight standard set at 135 percent of the mean body-mass value within each age bracket. For the males, 16-24 years-old, the qualification rates under the proposed revised standards are exactly the same as those under current standards, and they would be under no change in the standards were made.

As previously noted, for 16-24 year old, the application of the proposed revised standard requires a 10 percent increase in the qualification rates for the males. For the MA sample, 94.9 percent are qualified under the revised maximum standard, compared to the 77.0 percent under the current standard. For the MBANZ sample, 94.1 percent of 16-24 year old males, 91.4 percent and 90.1 percent, respectively, are qualified under the revised weight standard of 135 percent of mean body-mass, compared to the 70.4 percent and 72.5 percent, respectively, under the current standard. Similar increases of true percentages are also evident for each of the race ethnic subgroups under the proposed revised standard, compared to those qualified under current standard. A comparison of the qualification rates for males and females under the revised maximum weight standard reveals that females are still qualified at a lower rate than males, but that the large differences under the current standards are substantially reduced.

Table 11a

Comparison of the Percentages Qualified Under
Current AR 40-501 and Revised 135 Percent of Mean Body-mass
Maximum Weight Standards

16-24 Year-old Males and Females

Race	Males (BM w/H ²)			Females (BM w/H ^{1.5})		
	Current	Revised	Change	Current	Revised	Change
MALES						
White	96.8	96.5	0.0	76.8	94.9	+16.1
Black	96.5	96.5	0.0	66.6	90.0	+24.3
Miscellaneous	96.2	96.2	0.0	75.7	93.8	+18.1
Total	96.6	96.4	0.2	77.0	94.3	+17.3
FEMALES						
White	46.3	46.3	0.0	70.9	91.3	+20.4
Black	45.1	45.1	0.0	62.8	85.0	+22.2
Miscellaneous	46	46	0.0	77.5	89.5	+12.0
Total	45.9	45.9	0.0	76.3	90.4	+20.1
WHITES						
White	46	46	0.0	74.6	93.3	+18.5
Black	46	46	0.0	61.6	87.4	+26.2
Miscellaneous	47.1	47.1	0.0	66.9	87.5	+20.6
Total	46.3	46.3	0.0	72.5	92.7	+19.7

Table 11b presents the comparison of qualification rates under the current and proposed revised standards for males and females, aged 16-40 years, in the NHANES I and NHANES II samples. Overall, 96.2 percent of the males in the NHANES I sample are qualified under the revised standards, compared to 94.4 percent under the current standards. Among the NHANES II males, 96.6 percent are qualified under the revised standards compared to 94.8 percent under the current standards. The magnitude of the increases in qualification rates for the males, compared to the increases for the females, is mitigated by the fact that the standards were increased only for the older males, aged 25-40 years.

Among females, aged 16-40 years, there are substantial increases in the qualification rates under the 135 percent of mean body-mass maximum, compared to the qualification rates under current standards converted to body-mass. Under the proposed revised standards, 90.7 percent of all NHANES I females, and 90.8 percent of the NHANES II females are qualified, compared to 68.2 percent and 67.7 percent, respectively, under the current standards. Similar increases in the qualification rates for each of the racial/ethnic subgroup also result from the application of the revised standards. However, black females continue to have the lowest overall qualification rate. As was the case for the 16-24 year old females (Table 11a), the females in the 16-40 year-old analysis (Table 11b) are qualified at a lower rate than are the males, but the large differences present under the current standards are substantially reduced.

The principal cause for the lower overall qualification rate among

Table 11b

Comparison of the Percentages Qualified Under
Current AR 40-501 and Revised 135 Percent of Mean Body-mass
Maximum Weight Standards

16-40 Year-old Males and Females

	Males ($BM=W/H^2$)			Females ($BM=W/H^{1.5}$)		
	Current	Revised	Change	Current	Revised	Change
White	94.7	96.4	+1.7	70.5	91.7	+21.2
Black	90.5	93.7	+3.2	52.5	84.4	+31.9
Hispanic	97.5	97.8	+0.3	67.7	89.3	+21.6
Total	94.4	96.2	+1.8	68.2	90.7	+22.5
NHANES I*						
White	95.2	96.8	+1.6	70.5	92.2	+21.7
Black	95.0	96.1	+1.1	55.0	84.7	+29.7
Hispanic	88.2	93.3	+5.1	54.9	85.3	+30.4
Total	94.8	96.6	+1.8	67.7	90.8	+23.1

females, compared to males, under the proposed revised standards is attributable to differences in the rate of disqualification for overweightedness. Table 12 presents the percentage of males and females by data set, sex, race/ethnic group, and age bracket who would be disqualified for overweightedness under standards set at 135 percent of mean body-mass. As can be seen, the overall disqualification rate among females, aged 16-24 years, in the NLS sample is 3.2 percent compared to 2.0 percent for the males. Among the NHANES I and NHANES II females, aged 16-40 years, 6.5 percent and 7.1 percent, respectively, were overweight under the proposed revised standards, compared to 2.7 percent and 2.8 percent of the NHANES I and NHANES II males, respectively. Table 12 also shows that black females are disqualified at a substantially higher rate under the revised standards than are white and Hispanic females, and all the race/ethnic subgroups of males. The data presented in Table 12 also provide additional confirmation of our explanation that the percentage of females in the general population who are overweight is larger than that percentage of males.

Table 13 presents more clearly the effect on the rates of disqualification for overweightedness of the proposed revised maximum weight standards, compared to the current standards. This table presents the percentage point changes in rate of disqualification. Among young males, aged 16-24 years, no change is found since the weight standards were not revised. For the males in the older age brackets, and for all female age brackets, the proposed revised standards result in decreases in the disqualification rate for all race/ethnic sub-groups except the NHANES II 25-30 year old blacks. The decreases for all the female

Table 12

Percentage Overweight Under the 135 percent Mean Body-Mass
Maximum Weight Standards

	Males				Females			
	White	Black	Hispanic	Total	White	Black	Hispanic	Total
NLS								
16-20	2.0	1.5	1.7	1.9	2.2	5.1	2.2	2.6
21-24	2.2	1.7	3.5	2.2	3.6	7.3	3.8	4.1
16-24	2.1	1.6	2.3	2.0	2.8	6.0	2.8	3.2
NHANES I								
16-20	2.4	3.1	1.0	2.4	4.6	11.3	0.3	5.1
21-24	2.1	4.7	7.1	2.8	5.1	12.1	4.3	5.9
16-24	2.3	3.7	4.0	2.5	4.8	11.6	2.1	5.5
25-30	4.1	6.0	1.3	4.1	5.6	10.9	7.7	6.3
31-35	2.9	1.6	0.0	2.6	6.7	17.9	9.2	8.1
36-40	1.0	3.4	0.0	1.1	7.0	13.7	6.3	7.8
Total	2.6	3.8	2.3	2.7	5.6	12.8	4.9	6.5
NHANES II								
16-20	2.1	2.9	16.3	3.0	3.7	10.2	8.3	4.8
21-24	2.5	1.3	7.9	2.7	5.3	10.3	3.2	5.8
16-24	2.3	2.3	12.3	2.9	4.4	10.2	5.7	5.2
25-30	3.0	5.4	4.1	3.2	5.9	16.6	2.1	7.1
31-35	2.5	0.8	0.0	2.2	9.4	14.8	25.4	10.5
36-40	2.1	6.7	0.0	2.4	7.3	19.6	2.1	8.5
Total	2.5	3.3	6.4	2.8	6.1	13.9	6.5	7.1

Table 13
Comparison of Percentage Overweight
Under Current AR 40-501 and 135 percent Mean Body-Mass Maximum Weight Standards

	Males				Females			
	White	Black	Hispanic	Total	White	Black	Hispanic	Total
NLS								
16-20	0.0	0.0	0.0	0.0	-15.7	-23.6	-16.7	-16.9
21-24	0.0	0.0	0.0	0.0	-16.8	-25.2	-20.6	-18.0
16-24	0.0	0.0	0.0	0.0	-16.1	-24.2	-18.2	-17.3
NHANES I								
16-20	0.0	0.0	0.0	0.0	-18.0	-19.2	-11.8	-17.8
21-24	0.0	0.0	0.0	0.0	-23.5	-26.0	-12.2	-23.0
16-24	0.0	0.0	0.0	0.0	-20.4	-22.2	-12.0	-20.1
25-30	-2.1	-4.7	0.0	-2.3	-22.2	-35.9	-29.5	-24.1
31-35	-3.5	-2.0	0.0	-3.2	-18.8	-34.6	-37.4	-21.6
36-40	-4.4	-16.1	-1.4	-5.2	-25.1	-51.8	-28.3	-28.6
Total	-1.8	-3.2	-0.2	-1.8	-21.3	-31.9	-21.6	-22.5
NHANES II								
16-20	0.0	0.0	0.0	0.0	-18.8	-21.0	-18.4	-19.1
21-24	0.0	0.0	0.0	0.0	-18.1	-33.2	-22.7	-20.5
16-24	0.0	0.0	0.0	0.0	-18.5	-26.3	-20.6	-19.7
25-30	-0.9	0.0	-4.4	-1.0	-24.9	-29.9	-38.9	-26.4
31-35	-3.3	-3.4	-2.5	-3.3	-22.4	-36.3	-43.6	-24.4
36-40	-6.0	-5.0	-20.8	-7.0	-24.2	-35.7	-32.2	-26.2
Total	-1.6	-1.1	-5.2	-1.8	-21.7	-29.6	-30.4	-23.1

race/ethnic subgroups are substantial, compared to those for the males. These disproportionate decreases further indicate that the methodology employed in establishing the current maximum weight standards for females differs from, and is more conservative than, the methodology applied to males.

SECTION VII

Examination and Proposed Revision of Minimum Weight Standards

As shown in Section III, the current AR 40-501 minimum weight standards for enlistment converted to body-mass (Tables 8a and 8c), do not specify a single body-mass-value regardless of height. Further, when the maximum weight standards for males were revised in 1976 the minimum weight standards were not evaluated. Accordingly, in the general context of our assessment of the AR 40-501 standards, it was appropriate to examine the construction of the minimum standards, and if necessary, propose revisions. Further, our approach suggests that a single body-mass value for the minimum weight standards should be used for all heights, consistent with the methodology used for setting the maximum weight standards.

Our first step in examining the methodology used in establishing the current minimum standards was to compare the current standards to the mean body weight at each height for the individuals in each of the three data sets. This was the same procedure used to examine the maximum standards in Section IV, Tables 7a-1 through 7e-2. The only difference is that in the present case only the 16-20 year-old males and females were compared to the current standards, instead of all five of the male and female age brackets. AR 40-501 contains a single set of minimum weight standards that are applied regardless of age. Thus, the minimum weight standards are most likely to affect the youngest applicants since they are more likely than older people to be underweight, given the variability of the maturation process.

Tables 14a, 14b, and 14c present the mean body weight of the 16-20 year olds in the NLS, NHANES I, and NHANES II samples, respectively, and the mean body weight as a percentage of the current AR 40-501 standard expressed in pounds. Overall, the mean body weight as a percentage of the AR 40-501 standards is much the same for males and females. Among the NLS sample of 16-20 year-old males, between 62 and 73 inches tall, the percentages range from 123 percent to 134 percent, while the range for females, between 59 and 72 inches tall, is 121 percent to 128 percent (Table 14a). Among the NHANES I sample (Table 14b), the mean body weight as a percentage of the standard ranges from 117 percent to 134 percent for those males between 65 and 73 inches tall, while the range for females between 60 and 68 inches tall, is 118 percent to 129 percent. Among the NHANES II males, between 61 and 74 inches tall, the percentage ranges from 102 percent to 130 percent, while the range for females, between 61 and 68 inches tall, is 124 percent to 129 percent (Table 14c).

The data indicate that the variations in mean body weight as a percentage of the AR 40-501 standards between males and females are minor in magnitude suggesting that similar methodology was used to establish the minimum weight standard for both sexes. Thus, the analysis indicates that no major revisions of the current minimum weight standards are required. This leaves the task of specifying a single body-mass value for males and for females, regardless of height.

Table 8a shows that the current minimum body-mass value for males ranges from 17 to 20, with most heights having a value of 18. For

Table 14a
Comparison of Current AR 40-501 Minimum Weight Standards
and Mean Body Weight by Height
16-20 Year-old Males and Females
MLS Sample

Height (inches)	AR 40-501 Minimum Weight		Males		Females	
	Males	Females	Mean Body Weight	Percentage of AR 40-501	Mean Body Weight	Percentage of AR 40-501
58		90			104*	116
59		92			111	121
60	100	94	147*	147	114	121
61	102	96	127*	125	116	121
62	103	98	127	123	119	121
63	104	100	131	126	123	123
64	105	102	134	128	125	123
65	106	104	139	131	128	123
66	107	106	143	134	131	124
67	111	109	145	131	136	125
68	115	112	148	129	140	125
69	119	115	153	129	147	128
70	123	118	158	128	146	124
71	127	122	161	127	146	120
72	131	125	168	128	160*	128
73	135		172	127		
74	139		179	129		
75	143		185	129		
76	147		194	132		
77	151		199	132		
78	153		186*	122		
79	159		190*	119		
80	166		234*	141		

* Indicates 25 or fewer cases included in the calculation of the mean.

Table 14b
Comparison of Current AR 40-501 Minimum Weight Standards
and Mean Body Weight by Height
16-20 year old Males and Females

NHANES I Sample

Height (inches)	AR 40-501 Minimum Weight		Males		Females	
	Males	Females	Mean Body Weight	Percentage of AR 40-501	Mean Body Weight	Percentage of AR 40-501
58		90			115*	128
59		92			112*	122
60	100	94			117	124
61	102	96			117	122
62	103	98	125*	121	120	122
63	104	100	118*	113	129	129
64	105	102	147*	140	131	128
65	106	104	124	117	128	123
66	107	106	138	129	137	129
67	111	109	149	134	129	118
68	115	112	150	130	138	123
69	119	115	152	127	158*	137
70	123	118	161	131	136*	115
71	127	122	165	130	148*	121
72	131	125	168	128	140*	112
73	135		174	129		
74	139		178*	128		
75	143		172*	120		
76	147		176*	120		
77	151		171*	113		
78	153					
79	159					
80	166					

* Indicates 25 or fewer cases included in the calculation of the mean.

Table 14c
Comparison of Current AR 40-501 Minimum Weight Standards
and Mean Body Weight by Height
16-20 year old Males and Females
WHANES II Sample

Height (inches)	AR 40-501 Minimum Weight		Males		Females	
	Males	Females	Mean Body Weight	Percentage of AR 40-501	Mean Body Weight	Percentage of AR 40-501
58		90			118*	131
59		92			130*	141
60	100	94	118*	118	113*	120
61	102	96	104	102	119	124
62	103	98	127	123	126	129
63	104	100	132	127	126	126
64	105	102	129	123	131	128
65	106	104	134	126	132	127
66	107	106	139	130	134	126
67	111	109	141	127	137	126
68	115	112	146	127	142	127
69	119	115	151	127	150*	130
70	123	118	160	130	147*	125
71	127	122	158	124	155*	127
72	131	125	169	129	252*	202
73	135		167	124		
74	139		173	124		
75	143		186*	130		
76	147		201*	137		
77	151		221*	146		
78	153					
79	159					
80	166					

* Indicates 25 or fewer cases included in the calculation of the mean.

females, Table 8c shows a range of minimum body-mass values of 22 to 23, with a value of 22 specified for most heights. Using methodology similar to that used to construct new maximum weight standards (See Section V) resulted in the data presented in Table 15.

An examination of the reciprocals of the percentage of body weight to AR 40-501 standards (Tables 14a through 14c) indicated that, with some variation, the current minimum weight standard for both males and females is 80 percent of the mean body-mass. Accordingly, this percentage was applied to the mean body-mass values of the 16-20 year-old males and 16-20 year-old females in each of the three data sets. This resulted in the specification of a minimum body-mass standard of 18 for males, regardless of data set, and 22 for the females in the NLS and NHANES II samples, and 23 for the females in the NHANES I sample (see Table 15). Since the results from the NHANES II sample were used to establish the revised maximum weight standards, the NHANES II sample results were also used to set the proposed revised minimum weight standards.

Application of the single body-mass value of 18 for males and 22 for females resulted in very small changes in the overall qualification rates. (These changes were so small that they do not merit detailed presentation in a table.) Among the NLS sample of males and females, aged 16-24 years, the application of the new body-mass values for all heights resulted in a 1.2 percentage point increase and a 1.0 percentage point decrease, respectively, in the total percentage of qualified respondents. For the NHANES I sample of males and females, aged 16-24 years, the application of the new body-mass values for all heights resulted in a 1.2 percentage point increase and a 1.0 percentage point decrease, respectively, in the total percentage of qualified respondents. For the NHANES II sample of males and females, aged 16-24 years, the application of the new body-mass values for all heights resulted in a 1.2 percentage point increase and a 1.0 percentage point decrease, respectively, in the total percentage of qualified respondents.

Table 15

Summary of Body-mass Values:
 Current Minimum Weight Standards, Mean Body-mass
 80 Percent of Mean Body-mass, and Changes in standards

	16-20 Year-olds	
	(BM=W/H ²)	(BM=W/H ^{1.5})
Current Standards	17-20	22-23
<u>Mean Body-mass</u>		
NLS	23	28
NHANES I	23	29
NHANES II	23	28
<u>80 of Mean Body-mass</u>		
NLS	18	22
NHANES I	18	23
NHANES II	18	22
<u>Change: Current Standards vs. 80 of Mean Body-mass</u>		
NLS	-2/+1	-1/0
NHANES I	-2/+1	0/+1
NHANES II	-2/+1	-1/0

decreased .4 percentage point and .5 percentage point, respectively, in the overall qualification rate. Among females, aged 16-24 years, in the NHANES I and NHANES II samples the application of a body-mass index of 27, regardless of height, resulted in .5 percentage point increase in the overall qualification rate.

Among the 16-40 year old males in NHANES I and NHANES II samples, the effect of the proposed revision of the minimum standard resulted in a decrease of .2 percentage point in the overall qualification rate. For females, aged 16-40 years, this revision resulted in an increase of .5 percentage point in the NHANES I sample qualification rate and .4 percentage point increase in the NHANES II sample qualification rate.

SECTION VIII

Examination and Proposed Revision of Height Standards

Our assessment and proposed revision of weight standards have been based on applying sex neutral methodology. Thus, for both males and females, the minimum allowable weight was set at 80 percent of the mean body-mass and the maximum allowable weight was set at 135 percent of the mean body-mass. In this section we examine current height standards* and apply a similar sex neutral approach.

There does not appear to be any medically justifiable reason for considering sex in the specification of minimum and maximum height standards. However, the AR 40-501 standards currently permit females 5' or 59 inches tall to enter the military but excludes males of these heights. Females between 73 and 80 inches tall are excluded while in this height range are accepted. While the weight standard as a function of height, can be used to distinguish between a healthy one, in terms of overweight status, and a very tall one, is a healthy person or one who is overweight.

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DEVELOPMENT OF A METHODOLOGY FOR ESTABLISHING JOINT
SERVICE HEIGHT AND WEIGHT (U) DEFENSE MANPOWER DATA CENTER
ARLINGTON VA MARKET RESEARCH BR... NOV 85

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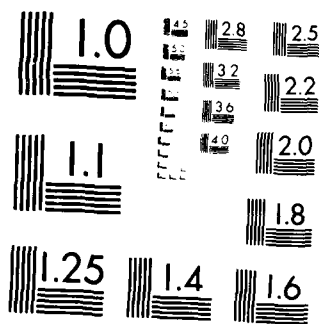
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

16-24 year-old and 16-40 year old age groupings in the NHANES I and NHANES II samples was 70 inches, while for females in both age groupings and samples the modal height was 64 inches. (Among the 16-24 year old males in the NLS sample the modal height was 72 inches, while for females in this age grouping the modal height was 64 inches. However, since these are self-reported data one should treat the NLS male modal height with some caution.)

The present AR 40-501 minimum and maximum height standards of 60 and 80 inches, respectively, (ignoring service differences) are plus and minus 10 inches around the modal height of 70 inches. For females, the present AR 40-501 minimum and maximum height standards are 58 and 72 inches, respectively, and are minus 6 inches and plus 12 inches around the modal height. If one were to set standards that took into account these sex differences in modal height, one might then select some consistent range around the modal value and apply it to both males and females. For example, if it were determined that plus and minus 10 inches, the range around the modal height for males currently in effect, is indeed the appropriate range, and then applied it to females, the minimum and maximum acceptable heights for females would be set at 54 and 74 inches, respectively. Conversely, if the range around the female modal height, minus 6 and plus 12 inches, were applied to the males, then the minimum and maximum acceptable heights would be set at 64 and 82 inches, respectively. However, neither of these approaches takes into account military realities and occupational requirements.

There is no analytic basis for questioning the absolute height of 58 inches as a minimum for females or the absolute height of 80 inches as

a maximum for males. However, if a short female is suitable for military service, it is unclear why an equally short male is not also suitable. Similarly, if a tall male is suitable for military service, it is unclear why an equally tall female is not also considered suitable. Accordingly, we propose application of the same 58 inches in height as the minimum for both males and females and the same 80 inches in height as the maximum for both males and females.

When these revised minimum and maximum height standards are applied to the three data sets the effect on overall qualification rates is negligible. (The changes in qualification rates are so small that they do not merit detailed presentation in a table.) Among the males and females, aged 16-24 years, the proposed revision in height standards resulted in an increase in the overall qualification rate of 1 percentage point. Among the 16-24 years and 16-40 year old groupings of males and females in the NHANES I sample, the revision resulted in no change in the overall qualification rates. For the NHANES II 16-24 year old sample of males, the overall qualification rate increased .1 percentage point, while the rate for the 16-24 year old females increased .2 percentage point. Among NHANES II males and females, the overall qualification rate increased .1 percentage point each when the revised height standards were applied.

SECTION IX

An Interim Summary

The Proposed Revisions and Their Effect

Thus far, our analysis has resulted in a number of proposed revisions to the current AR 40-501 height and weight standards. The proposals which have been examined in detail are:

1. Breaking the age bracket for 21-30 year-old males in Table I of Appendix III of AR 40-501 into two age brackets, one for 21-25 years, and another for 26-30 years.
2. Changing the age range for females in Table II of Appendix III of AR 40-501 from 18-20 years to 16-20 years.
3. Adjusting the weights in Tables I and II of Appendix III to reflect the minimum weight of the body-mass range for the minimum required weight, and to reflect the maximum weight of the body-mass range for the maximum allowable weight.
4. For older male and all female age brackets, establishing a single maximum body-mass value to be applied regardless of height determined by using the same methodology as currently applied to younger males. Accordingly, a body-mass value of 135 percent of the mean body-mass, for each age bracket, was applied for all males and females as the maximum allowable weight.

5. For males and females establishing a single minimum body-mass value to be applied regardless of height. Accordingly, a body-mass value of 80 percent of the mean body-mass of males and females, aged 16-20 years, was applied for all males and females, as the minimum required weight.
6. The minimum and maximum height standards for males and females should be the same, with the minimum height set at 58 inches, and the maximum height set at 80 inches.

The percentage of 16-24 year-old males and females in each of the three data sets who would be qualified under all the proposed changes to the height and weight standards are presented in Table 16. Among the males in the NLS sample, the NHANES I, and the NHANES II sample, 96.7 percent, 95.5 percent, and 95.7 percent, respectively, are qualified. For females, the comparable qualification rates are 94.9 percent, 90.9 percent, and 92.9 percent. These data indicate that even when the same methodology in establishing height and weight standards for males and females is applied, females are still, as under the current AR 40-501 standards, qualified at a lower rate. This result is due principally to the earlier reported finding that, in general, more females than males are overweight.

The qualification rates among the race/ethnic subgroups of males presented in Table 16 are similar, with the exception of the NHANES II sample of Hispanics. Among the female race/ethnic subgroups, the

Table 16
Percentage of Qualified and Not Qualified
Under Revised Height and Weight Standards

16-24 Year-old Males and Females

	Males				Females			
	White	Black	Hispanic	Total	White	Black	Hispanic	Total
NLS								
Qualified	96.7	96.5	95.8	96.7	95.5	91.2	95.0	94.9
Not Qualified:								
Underheight	0.0	0.0	0.0	0.0	0.3	1.6	0.8	0.5
Overheight	0.0	0.3	0.0	0.1	0.0	0.0	0.0	0.0
Underweight	1.2	1.6	1.9	1.2	1.5	1.2	1.4	1.5
Overweight	2.1	1.6	2.3	2.0	2.8	6.0	2.8	3.2
	3.3	3.5	4.2	3.3	4.5	9.8	5.0	5.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NHANES I								
Qualified	95.7	93.1	96.0	95.5	91.8	85.2	89.5	90.9
Not Qualified:								
Underheight	0.0	0.0	0.0	0.0	0.4	0.5	4.3	0.6
Overheight	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Underweight	2.0	3.2	0.0	2.0	3.0	2.6	4.1	3.0
Overweight	2.3	3.7	4.0	2.5	4.8	11.6	2.1	5.5
	4.3	6.9	4.0	4.5	8.2	4.8	10.5	9.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NHANES II								
Qualified	96.3	96.4	87.1	95.7	94.1	88.1	88.4	92.9
Not Qualified:								
Underheight	0.0	0.0	0.0	0.0	0.4	0.4	3.7	0.6
Overheight	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Underweight	1.5	1.4	0.6	1.4	1.2	1.3	2.3	1.3
Overweight	2.3	2.3	12.3	2.9	4.4	10.2	5.7	5.2
	3.7	3.6	12.9	4.3	5.9	11.9	11.6	7.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

qualification rate of blacks is lower than that for whites in all three data sets. Compared to Hispanic females, black females are disqualified at a higher rate in the NLS and NHANES I samples. In the NHANES II sample, the qualification rate for black and Hispanic females are similar. This result is consistent with the earlier reported finding that more black females are overweight than white and Hispanic females (see Table 6). While females are still qualified at a lower rate than males, the very large disparity in rates under current standards (See Table 3a) is substantially reduced.

Tables 17a, 17b, and 17c summarize the effect of the proposed revision of the standards for the NLS, NHANES I, and NHANES II 16-24 year-old samples. Table 17a shows that among the NLS sample of males, aged 16-24 years, the net effect of the revisions is an 0.8 percentage point increase in the overall qualification rate. The comparable change for NLS sample females is an increase of 20.5 percentage points. Most of this increase (17.3 percentage points) in the overall qualification rate is attributable to the revision of the maximum weight standards. Among the NHANES I and NHANES II samples of males, aged 16-24 years, the net increases in the qualification rate are 1.1 percentage point (see Table 17b) and .4 percentage point (see Table 17c), respectively. The qualification rate increased 25.5 percentage points for the NHANES I females (see Table 17b) and 25.1 percentage points for the NHANES II females (see Table 17c), aged 16-24 years. Most of these increases (20.1 and 19.7 percentage points, respectively) are attributable to the revision of the weight standards.

Table 18 presents the overall qualification rates after the

Table 17a

Summary of the Effect of Changes in
AR 40-501 Height and Weight Standards
16-24 Year-old Males and Females

NLS Sample

	Males					Females				
	Qualified	Not Qualified			Total	Qualified	Not Qualified			Total
		Height		Weight			Height		Weight	
		Under	Over	Under	Over		Under	Over	Under	Over
Current AR 40-501 Standards Conversion to Body-mass	95.9 1.1	0.1	0.1	1.3 (0.2)	2.7 (0.7)	74.4 2.6	0.5	0.1	3.0 (1.1)	22.0 (1.5)
Current AR 40-501 in Body-mass Revision to 13% of Mean Body-mass	96.8 0.0	0.1	0.1	1.1	2.0 0.0	77.0 17.3	0.5	0.1	1.9	20.5 (17.3)
Revised Maximum Weight Standards Revision of Minimum Weight Standards	96.8 (0.2)	0.1	0.1	1.1	2.0	94.3 0.5	0.5	0.1	1.9 (0.4)	3.2
Revised Minimum and Maximum Weight Standards Revision of Height Standards	96.6 0.1	0.1 (0.1)	0.1	1.2 0.0	2.0 0.0	94.8 0.1	0.5	0.1 (0.1)	1.5 0.0	3.2
Revised Weight and Height Standards	96.7	0.0	0.1	1.2	2.0	94.9	0.5	0.0	1.5	3.2
Net Effect of All Revisions	0.8	(0.1)	0.0	(0.1)	(0.7)	20.5	0.0	(0.1)	(1.5)	(18.8)

Table 17b

Summary of the Effect of Changes in
AR 40-501 Height and Weight Standards
16-24 Year-old Males and Females

NHANES I Sample

	Males						Females					
	Qualified	Not Qualified				Qualified	Not Qualified					
		Height		Weight			Height		Weight			
		Under	Over	Under	Over		Under	Over	Under	Over		
Current AR 40-501 Standards Conversion to Body-ma-s	94.4 1.5	5.6 (1.5)	0.0 —	0.0 —	2.1 (0.5)	3.5 (1.0)	65.4 4.9	0.6 —	0.0 —	34.6 (4.9)	5.3 (1.8)	28.7 (3.1)
Current AR 40-501 in Body-mass Revision to 135% of Mean Body-mass	95.9 0.0	4.1 0.0	0.0 —	0.0 —	1.6 —	2.5 0.0	70.3 20.1	0.6 —	0.0 —	29.7 (20.1)	3.5 —	25.6 (20.1)
Revised Maximum Weight Standards Revision of Minimum Weight Standards	95.9 (0.4)	4.1 0.4	0.0 —	0.0 —	1.6 0.4	2.5 —	90.4 0.5	0.6 —	0.0 —	9.6 (0.5)	3.5 (0.5)	5.5 —
Revised Minimum and Maximum Weight Standards Revision of Height Standards	95.5 0.0	4.5 0.0	0.0 0.0	0.0 0.0	2.0 0.0	2.5 0.0	90.9 0.0	0.6 0.0	0.0 0.0	9.1 0.0	3.0 0.0	5.5 0.0
Revised Weight and Height Standards	95.5	4.5	0.0	0.0	2.0	2.5	90.9	0.6	0.0	9.1	3.0	5.5
Net Effect of All Revisions	1.1	(1.1)	0.0	0.0	(0.1)	(1.0)	25.5	0.0	0.0	(25.5)	(2.3)	(23.2)

Table 17c

Summary of the Effect of Changes in
AR 40-501 Height and Weight Standards
16-24 Year-old Males and Females

NHANES II Sample

	Males						Females							
	Qualified	Not Qualified			Total	Qualified	Not Qualified			Total	Qualified	Not Qualified		
		Height		Weight			Height		Weight			Height		Weight
		Under	Over				Under	Over				Under	Over	
Current AR 40-501 Standards Conversion to Body-mass	95.3 0.6	4.7 (0.6)	0.1 —	0.0 —	1.5 (0.5)	3.1 (0.2)	67.8 4.7	32.2 (4.7)	0.6 —	0.2 —	3.5 (1.7)	27.9 (3.0)		
Current AR 40-501 in Body-mass Revision to 135% of Mean Body-mass	95.9 0.0	4.1 0.0	0.1 —	0.0 —	1.0 —	2.9 0.0	72.5 19.7	27.5 (19.7)	0.6 —	0.2 —	1.8 —	24.9 (19.7)		
Revised Maximum Weight Standards Revision of Minimum Weight Standards	95.9 (0.3)	4.1 0.3	0.1 —	0.0 —	1.0 0.4	2.9 —	92.2 0.5	7.8 (0.5)	0.6 —	0.2 —	1.8 (0.5)	5.2 —		
Revised Minimum and Maximum Weight Standards Revision of Height Standards	95.6 0.1	4.4 (0.1)	0.1 (0.1)	0.0 0.0	1.4 0.0	2.9 0.0	92.7 0.2	7.3 (0.2)	0.6 0.0	0.2 (0.2)	1.3 0.0	5.2 0.0		
Revised Weight and Height Standards	95.7	4.3	0.0	0.0	1.4	2.9	92.9	7.1	0.6	0.0	1.3	5.2		
Net Effect of All Revisions	0.4	(0.4)	(0.1)	0.0	(0.1)	(0.2)	25.1	(25.1)	0.0	(0.2)	(2.2)	(22.7)		

application of the proposed revisions for the 16-40 year-old NHANES I and NHANES II samples. The results are similar to those reported for the 16-24 year-old samples, with females qualified at a lower rate than males, and black females disqualified at a higher rate than white females.

Tables 19a and 19b summarize the effect of all the proposed revisions on qualification rates for the NHANES I and NHANES II, 16-40 year-old males and females. Among the NHANES I males the overall qualification rate increased 3.1 percentage points while the rate for females increased 26.7 percentage points (see Table 19a). Of the total increase in the qualification rate among NHANES I females, 22.5 percentage points is due to the revision of the maximum weight standards. The increase in qualification rates for NHANES II 16-40 year old males and females is 3.0 percentage points and 27.4 percentage points, respectively (see Table 19b). Of the total increase for the NHANES II females, 23.1 percentage points is due to revision of the maximum weight standards.

Details of the rates of overweightedness for each age and race/ethnic group presented in Tables 16 and 18 were discussed earlier in Section VI of this report and can be found in Table 12.

Presented in Tables 20a and 20b are comparisons of the current AR 40-501 height and weight (in pounds) standards and the proposed revised standards (converted to pounds from body-mass) for males and females, respectively. These tables reflect the modification of the age brackets, and include males 58 or 59 inches tall and females 72 to 80 inches tall. For the males (Table 20a), the adjustments in the minimum weight standards

Table 18
Percentage Qualified and Not Qualified
Under Revised AR 40-501 Height and Weight Standards
16-40 Year-old Males and Females

	Males				Females			
	White	Black	Hispanic	Total	White	Black	Hispanic	Total
NHANES I								
Qualified	96.2	93.7	97.8	96.0	92.2	84.6	89.4	91.2
Not Qualified:								
Underheight	0.0	0.0	0.0	0.0	0.4	0.4	3.5	0.5
Overheight	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Underweight	1.2	2.5	0.0	1.3	1.8	2.3	2.2	1.9
Overweight	2.6	3.8	2.2	2.7	5.6	12.8	4.9	6.5
	3.8	6.3	2.2	4.0	7.8	15.4	10.6	8.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NHANES II								
Qualified	96.8	96.1	93.3	96.5	92.7	85.0	85.7	91.3
Not Qualified:								
Underheight	0.0	0.0	0.0	0.0	0.2	0.2	5.2	0.5
Overheight	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Underweight	0.8	0.7	0.3	0.7	1.0	0.9	2.6	1.1
Overweight	2.5	3.3	6.4	2.8	6.1	13.9	6.5	7.1
	3.2	3.9	6.7	3.5	7.3	15.0	14.3	8.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 19a

Summary of the Effect of Changes in
AR 40-501 Height and Weight Standards
16-40 Year-old Males and Females

NRANES I Sample

	Males										Females									
	Qualified					Not Qualified					Qualified					Not Qualified				
	Total	Under	Over	Weight	Height	Total	Under	Over	Weight	Height	Total	Under	Over	Weight	Height	Total	Under	Over	Weight	Height
Current AR 40-501 Standards Conversion to Body-mass	92.9 1.5	7.1 (1.5)	0.0 -	0.0 (0.2)	5.8 (1.3)	64.5 3.7	35.5 (3.7)	0.5 -	0.0 -	31.6 (2.6)	31.8 (22.5)	0.5 -	0.0 -	2.3 -	3.4 (1.1)	35.5 (3.7)	0.5 -	0.0 -	3.4 (1.1)	31.6 (2.6)
Current AR 40-501 in Body-mass Revision to 135% of Mean Body-mass	94.4 1.8	5.6 (1.8)	0.0 -	1.1 -	4.5 (1.8)	68.2 22.5	31.8 (22.5)	0.5 -	0.0 -	29.0 (22.5)	90.7 0.5	9.3 (0.5)	0.5 -	0.0 -	2.3 (0.4)	90.7 0.5	0.5 -	0.0 -	2.3 (0.4)	6.5 -
Revised Maximum Weight Standards Revision of Minimum Weight Standards	96.0 0.0	4.0 0.0	0.0 0.0	1.3 0.0	2.7 0.0	91.2 0.0	8.8 0.0	0.5 0.0	0.0 0.0	1.9 0.0	91.2 0.0	8.8 0.0	0.5 0.0	0.0 0.0	1.9 0.0	91.2 0.0	0.5 0.0	0.0 0.0	1.9 0.0	6.5 0.0
Revised Minimum and Maximum Weight Standards Revision of Height Standards	96.0 0.0	4.0 0.0	0.0 0.0	1.3 0.0	2.7 0.0	91.2 0.0	8.8 0.0	0.5 0.0	0.0 0.0	1.9 0.0	91.2 0.0	8.8 0.0	0.5 0.0	0.0 0.0	1.9 0.0	91.2 0.0	0.5 0.0	0.0 0.0	1.9 0.0	6.5 0.0
Revised Weight and Height Standards	96.0 0.0	4.0 0.0	0.0 0.0	1.3 0.0	2.7 0.0	91.2 0.0	8.8 0.0	0.5 0.0	0.0 0.0	1.9 0.0	91.2 0.0	8.8 0.0	0.5 0.0	0.0 0.0	1.9 0.0	91.2 0.0	0.5 0.0	0.0 0.0	1.9 0.0	6.5 0.0
Net Effect of All Revisions	3.1 0.0	(3.1) 0.0	0.0 0.0	0.0 0.0	(3.1) 0.0	26.7 0.0	(26.7) 0.0	0.0 0.0	0.0 0.0	(1.5) 0.0	26.7 0.0	(26.7) 0.0	0.0 0.0	0.0 0.0	(1.5) 0.0	26.7 0.0	0.0 0.0	0.0 0.0	(1.5) 0.0	(25.1) 0.0

Table 19b

Summary of the Effect of Changes in
AR 40-501 Height and Weight Standards

16-40 Year-old Males and Females

NHANES II Sample

	Males						Females									
	Qualified	Not Qualified			Qualified			Not Qualified			Qualified					
		Total	Height		Weight		Total	Height		Weight		Total	Height		Weight	
			Under	Over	Under	Over		Under	Over	Under	Over		Under	Over	Under	Over
Current AR 40-501 Standards Conversion to Body-mass	93.5 1.3	6.5 (1.3)	0.1 -	0.0 -	0.9 (0.4)	5.5 (0.9)	63.9 3.8	0.5 -	0.1 -	2.6 (1.1)	32.9 (2.7)					
Current AR 40-501 in Body-mass Revision to 135% of Mean Body-mass	94.8 1.8	5.2 (1.8)	0.1 -	0.0 -	0.5 -	4.6 (1.8)	67.7 23.1	0.5 -	0.1 -	1.5 -	30.2 (23.1)					
Revised Maximum Weight Standards Revision of Minimum Weight Standards	96.6 (0.2)	3.4 0.2	0.1 -	0.0 -	0.5 0.2	2.8 -	90.8 0.4	0.5 -	0.1 -	1.5 (0.4)	7.1 -					
Revised Minimum and Maximum Weight Standards Revision of Height Standards	96.4 0.1	3.6 (0.1)	0.1 (0.1)	0.0 0.0	0.7 0.0	2.8 0.0	91.2 0.1	0.5 0.0	0.1 (0.1)	1.1 0.0	7.1 0.0					
Revised Weight and Height Standards	96.5	3.5	0.0	0.0	0.7	2.8	91.3	0.5	0.0	1.1	7.1					
Net Effect of All Revisions	3.0	(3.0)	(0.1)	0.0	(0.2)	(2.7)	27.4	0.0	(0.1)	(1.5)	(25.8)					

Table 20a

Comparison of Current AR 40-501 and Revised Height and Weight Standards
(in Pounds, with Maximum Weight Set at 135 Percent of Mean Body-Mass)

Males

Height (Inches)	Minimum			Maximum								
	AR 40-501	80% BM	Change	16-20 yrs			21-24 yrs			25-30 yrs		
				AR 40-501	135% BM	Change	AR 40-501	135% BM	Change	AR 40-501	135% BM	Change
58	-	84	-	-	150	-	-	155	-	-	165	-
59	-	87	-	-	155	-	-	160	-	-	170	-
60	100	90	-10	158	161	+3	163	166	+3	163	176	+9
61	102	93	-9	163	166	+3	168	172	+4	168	182	+4
62	103	96	-7	168	172	+4	174	177	+3	174	188	+14
63	104	99	-5	174	177	+3	180	183	+3	180	194	+14
64	105	102	-3	179	183	+4	185	189	+4	185	200	+15
65	106	106	0	185	189	+4	191	195	+4	191	207	+16
66	107	109	+2	191	195	+4	197	201	+4	197	213	+16
67	111	112	+1	197	201	+4	203	207	+4	203	220	+17
68	115	116	+1	203	207	+4	209	213	+4	209	226	+17
69	119	119	0	209	213	+4	215	220	+5	215	233	+18
70	123	122	-1	215	219	+4	222	226	+4	222	240	+18
71	127	126	-1	221	225	+4	228	233	+5	228	247	+19
72	131	130	-1	227	232	+5	234	240	+6	234	254	+20
73	135	133	-2	233	237	+4	241	246	+5	241	261	+20
74	139	137	-2	240	245	+5	248	253	+5	248	268	+20
75	143	141	-2	246	252	+6	254	260	+6	254	276	+22
76	147	144	-3	253	258	+5	261	266	+5	261	283	+22
77	151	148	-3	260	265	+5	268	274	+6	268	290	+22
78	153	152	-1	267	272	+5	275	281	+6	275	298	+23
79	159	156	-3	273	279	+6	282	288	+6	282	306	+24
80	166	160	-6	280	286	+6	289	295	+6	289	314	+25

Table 20a (Continued)

Comparison of Current AR 40-501 and Revised Height and Weight Standards
(in Pounds, with Maximum Weight Set at 135 Percent of Mean Body-Mass)

Males

Maximum									
31-35 yrs			36-40 yrs			41 yrs and over			Height (Inches)
AR 40-501	135% BM	Change	AR 40-501	135% BM	Change	AR 40-501	135% BM	Change	
-	170	-	-	170	-	-	170	-	58
-	175	-	-	175	-	-	175	-	59
162	181	+19	157	181	+24	150	181	+31	60
167	187	+20	162	187	+25	155	187	+32	61
173	194	+21	168	194	+26	160	194	+34	62
178	200	+22	173	200	+27	165	200	+35	63
184	206	+22	179	206	+27	171	206	+35	64
190	213	+23	184	213	+29	176	213	+37	65
196	219	+23	190	219	+29	182	219	+37	66
202	226	+24	196	226	+30	187	226	+39	67
208	233	+25	202	233	+31	193	233	+40	68
214	240	+26	208	240	+32	198	240	+42	69
220	247	+27	214	247	+33	204	247	+43	70
227	254	+27	220	254	+34	210	254	+44	71
233	261	+28	226	261	+35	216	261	+45	72
240	269	+29	233	269	+36	222	269	+47	73
246	276	+30	239	276	+37	228	276	+48	74
253	284	+31	246	284	+38	234	284	+50	75
260	291	+31	252	291	+39	241	291	+50	76
266	299	+33	259	299	+40	247	299	+52	77
273	307	+34	266	307	+41	254	307	+53	78
281	315	+34	273	315	+42	260	315	+55	79
288	323	+35	279	323	+44	267	323	+56	80

result in small decreases in the minimum acceptable weights, except for those whose height is less than 63 inches or at 80 inches. For the males aged 16-20 years-old and 21-24 years-old, the maximum weight permitted was increased 3 to 6 pounds. These changes are due to the use of the upper limit of the body-mass value when expressed in pounds. For the males in the 25-30 year-old age bracket, the maximum allowed weight under the 135 percent of mean body-mass standard was increased by 9 to 25 pounds. For the 31-35 year-old and 36-40 year-old males, the maximum allowed weight was increased by 19 to 35 pounds and 24 to 44 pounds, respectively.

(The analysis, to this point, has not considered the weight standards for those in the 41 years and over age bracket. Since this is an open-ended age bracket it presents analytic problems in that an end-point is required to perform calculations. Following the present methodology, which includes five years in each age bracket, the mean body-mass for the age-bracket of 41-45 years and the maximum weight standard of 135 percent of mean body-mass were calculated. For the NHANES II males and females, ages 41-45 years, the mean body-masses were 26 and 32, respectively, and the maximum weight standard body-masses of 135 percent of mean body-mass were 35 and 43, respectively. These values are the same as those that apply to the 31-35 year-old and 36-40 year-old males and 36-40 year-old females.)

For the females (Table 20b), the revision of the minimum weight standards resulted in lower required weights of 3 to 9 pounds. Application of the 135 percent of mean body-mass standard resulted in increases

in the maximum allowable weight of 31 to 45 pounds for the 16-20 year-old and 21-24 year-old females. For the older females, aged 25-30 years, 31-35 years, and 36-40 years, the increases in the maximum allowable weight range from 37 to 57 pounds.

Reconsideration of the Proposed Revision of the Maximum Weight Standards

The effects of these revisions are certain to result in a pause. The application of the 135 percent of mean body-mass standard, currently in effect for young males, aged 16-24 years, to the older males and all female age brackets has a dramatic effect on the maximum weight standards. A 26 year-old, 5'10" (70 inches) male who weighs 240 pounds, or a 25 year-old, 5'5" (65 inches) female who weighs 194 pounds, are clearly very heavy, and probably clinically overweight, and their suitability for military service subject to question. One might suggest that even if the methodology used to construct these tables is correct, and that it should be consistently applied to both males and females in each of the five age brackets, the results are not realistic.

The discussion in Section IV of overweightedness stated that an individual whose weight is 20 percent or more in excess of the mean weight is considered to be medically overweight. Thus, an inconsistency between medical practice and the present AR 40-501 maximum weight standards for males aged 16-24 years exists. Already, and in the absence of any revision in the AR 40-501 maximum weight standards, some percentage of young males who are fully qualified under the current AR 40-501 standards for military service are also overweight. Clearly, a standard that establishes the maximum allowable weight at 135 percent of the mean

Table 20b

Comparison of Current AR 40-501 and Revised Height and Weight Standards
(in Pounds, with Maximum Weight Set at 135 Percent of Mean Body-Mass)

Females

Height (Inches)	Minimum			Maximum								
	AR 40-501	80% BM	Change	16-20 yrs			21-24 yrs			25-30 yrs		
				AR 40-501	135% BM	Change	AR 40-501	135% BM	Change	AR 40-501	135% BM	Change
58	90	85	-5	120	151	+31	124	155	+31	126	163	+37
59	92	87	-5	122	155	+33	126	159	+33	128	167	+39
60	94	90	-4	124	159	+35	128	163	+35	130	172	+42
61	96	92	-4	127	163	+36	130	167	+37	132	176	+44
62	98	94	-4	128	167	+39	132	172	+40	134	180	+46
63	100	96	-4	132	171	+39	134	176	+42	136	185	+49
64	102	99	-3	135	175	+40	136	180	+44	139	189	+50
65	104	101	-3	138	180	+42	140	184	+44	144	194	+50
66	106	103	-3	141	184	+43	145	189	+44	148	198	+50
67	109	106	-3	145	188	+43	149	193	+44	152	203	+51
68	112	108	-4	150	192	+42	153	197	+44	156	207	+51
69	115	110	-5	154	196	+42	157	202	+45	161	212	+51
70	118	113	-5	158	201	+43	162	206	+44	165	216	+51
71	122	115	-7	162	205	+43	166	210	+44	169	221	+52
72	125	118	-7	167	209	+42	171	215	+44	174	226	+52
73	128	120	-8	171	214	+43	177	219	+42	179	231	+52
74	130	123	-7	175	218	+43	182	224	+42	185	235	+50
75	133	125	-8	179	223	+44	187	228	+41	190	240	+50
76	136	128	-8	184	227	+43	192	233	+41	196	245	+49
77	139	130	-9	188	232	+44	197	238	+41	201	250	+49
78	141	133	-8	192	236	+44	203	242	+39	206	255	+49
79	144	135	-9	196	241	+45	208	247	+39	211	260	+49
80	147	138	-9	201	245	+44	213	252	+39	216	265	+49

Table 20b (Continued)

Comparison of Current AR 40-501 and Revised Height and Weight Standards
(in Pounds, with Maximum Weight Set at 135 Percent of Mean Body-Mass)

Females

Maximum									
31-35 yrs			36-40 yrs			41 yrs and over			Height (Inches)
AR 40-501	135% BM	Change	AR 40-501	135% BM	Change	AR 40-501	135% BM	Change	
129	167	+38	132	171	+39	135	171	+36	58
131	171	+40	134	175	+41	137	175	+38	59
133	176	+43	136	180	+44	139	180	+41	60
135	180	+45	139	184	+45	141	184	+43	61
137	185	+48	140	189	+49	144	189	+45	62
139	189	+50	143	194	+51	145	194	+49	63
143	194	+51	145	198	+53	149	198	+49	64
148	198	+50	150	203	+53	153	203	+50	65
151	203	+52	154	208	+54	157	208	+51	66
156	208	+52	158	212	+54	162	212	+50	67
160	212	+52	162	217	+55	166	217	+51	68
164	217	+53	167	222	+55	170	222	+52	69
168	222	+54	171	227	+56	174	227	+53	70
173	226	+53	175	232	+57	179	232	+53	71
178	231	+53	181	237	+56	184	237	+53	72
183	236	+53	186	242	+56	190	242	+52	73
188	241	+53	191	247	+56	195	247	+52	74
194	246	+52	196	252	+56	200	252	+52	75
199	251	+52	202	257	+55	205	257	+52	76
204	256	+52	207	262	+55	211	262	+51	77
209	261	+52	213	267	+54	216	267	+51	78
215	266	+51	218	272	+54	220	272	+52	79
219	271	+52	223	277	+54	225	277	+52	80

body-mass is one that includes males who are overweight using 120 percent of mean body-mass as the criterion for overweightedness. When the 135 percent mean body-mass standard is applied to older males and all females in establishing the maximum weight standard, the problem is extended.

Presented in Table 21 are the percentages of males and females who would be qualified under the proposed maximum weight standards but who would also be considered medically overweight. Among the males, aged 16-40 years, 3.7 percent of the NLS sample, 5.1 percent of the NHANES I sample, and 4.8 percent of the NHANES II sample are medically overweight. Among the females, aged 16-40 years, 4.1 percent, 6.3 percent, and 7.1 percent of the NLS, NHANES I and NHANES II samples, respectively, are medically overweight.

The text of the current AR 40-501 offers one solution to this dilemma. Section XII, Paragraph 2-23d, states: "Even though the individual's weight is within the maximum shown in table I or II, as appropriate, appendix III, he will be reported as medically unacceptable when the medical examiner considers the individual's weight, in relation to the body structure and musculature, constitutes obesity of such a degree as to interfere with the satisfactory completion of prescribed training." Thus, the standards setting the maximum allowable weight at 135 percent of the mean body-mass could be implemented at that level and cases of overweightedness handled by application of Paragraph 2-23d. However, such an approach might tend to undermine the desired objectivity of the maximum weight standards in screening applicants for military

Table 21

Percentage of Qualified but Medically Overweight
Under Maximum Weight Standard of 135 percent Mean Body-Mass

	Males				Females			
	White	Black	Hispanic	Total	White	Black	Hispanic	Total
NLS								
16-20	3.4	2.3	5.8	3.3	3.7	5.0	1.6	3.8
21-24	4.6	3.5	2.0	4.4	4.1	6.5	5.3	4.5
16-24	3.9	2.8	4.5	3.7	3.9	5.6	3.0	4.1
NIHANS I								
16-20	5.8	3.1	4.2	5.4	4.9	3.7	2.6	4.6
21-24	5.6	1.8	3.6	5.0	4.1	9.1	3.2	4.6
16-24	5.7	2.6	3.9	5.2	4.5	6.0	2.9	4.6
25-30	4.2	6.4	7.4	4.5	6.6	11.2	21.1	7.7
31-35	5.9	2.0	3.4	5.4	5.8	12.6	7.6	6.7
36-40	4.5	16.1	1.4	5.2	8.4	15.5	0.7	8.8
Total	5.2	4.9	4.2	5.1	5.8	9.8	6.3	6.3
NIHANS II								
16-20	2.6	3.6	7.9	3.1	5.6	3.2	3.0	5.2
21-24	5.5	4.2	4.3	5.3	5.5	13.1	4.9	6.4
16-24	3.9	3.9	6.2	4.0	5.6	7.5	4.0	5.7
25-30	4.1	5.9	7.0	4.4	7.2	12.7	13.8	8.3
31-35	5.0	9.2	2.5	5.3	7.0	11.8	19.8	7.9
36-40	6.4	5.1	20.8	7.4	7.4	13.1	6.0	8.0
Total	4.5	5.4	8.5	4.8	6.5	10.2	9.0	7.1

service. The intent of Paragraph 2-23d is to permit medical judgement in those exceptional cases where an individual meets the objective weight standard, but is still not suitable for military service. It is not unlikely that the few "exceptional" cases that arise under the current AR 40-501 maximum weight standards would become common cases under the 135 percent of mean body-mass standards.

In the next section of this report we examine an alternative that sets the maximum weight standards at 120 percent of mean body-mass and assess its effect of qualification rates.

SECTION X

Alternative Maximum Weight Standards

As an alternative to retaining the maximum weight standards for 16-24 year-old males (the initial analytic constraint), and applying the methodology used to set those standards to the older males and all females, we propose that the problem described above of qualifying overweight individuals be resolved by removing the analytic constraint. Accordingly, we examined the proposal that the maximum weight standards for all males and all females be set at 120 percent of the mean body-mass in each age bracket. This will result in the exclusion of all persons who are characterized as medically overweight and ensure that cases that fall under the provisions of AR 40-501, Paragraph 2-23d will remain exceptional.

Table 22a presents a comparison of the current AR 40-501 height and weight (in pounds) standards and revised standards using a 120 percent of mean body-mass standard (converted to pounds) for males. This table shows a reduction in the maximum allowable weight for males, aged 16-20 years and 21-25 years of 12-21 pounds, depending on height, compared to the minor increases of 3 to 6 pounds presented in Table 20a under the 135 percent mean body-mass standard. For the 26-30 year-old males, Table 26a shows a decrease of 7 to 12 pounds under the 120 percent mean body-mass standard compared to the increases of 9 to 25 pounds shown in Table 20a. While the 135 percent mean body-mass standard results presented in Table 20a showed increases of 19 to 35 and 24 to 44 pounds for males aged 31-35 and 36-40 years, respectively, Table 22a shows a

Table 22a

Comparison of Current AR 40-501 and Revised Height and Weight Standards
(in Pounds, with Maximum Weight Set at 120 Percent of Mean Body-Mass)

Males

Height (Inches)	Minimum			Maximum								
	AR 40-501	80% BM	Change	16-20 yrs			21-24 yrs			25-30 yrs		
				AR 40-501	120% BM	Change	AR 40-501	120% BM	Change	AR 40-501	120% BM	Change
58	-	84	-	-	136	-	-	141	-	-	145	-
59	-	87	-	-	141	-	-	146	-	-	151	-
60	100	90	-10	158	145	-7	163	151	-12	163	156	-7
61	102	93	-9	163	150	-13	168	156	-12	168	161	-7
62	103	96	-7	168	155	-13	174	161	-13	174	166	-8
63	104	99	-5	174	160	-14	180	166	-14	180	172	-8
64	105	102	-3	179	166	-13	185	171	-14	185	177	-8
65	106	106	0	185	171	-14	191	177	-14	191	183	-8
66	107	109	+2	191	176	-15	197	182	-15	197	188	-9
67	111	112	+1	197	181	-16	203	188	-15	203	194	-9
68	115	116	+1	203	187	-16	209	194	-15	209	200	-9
69	119	119	0	209	192	-17	215	199	-16	215	206	-9
70	123	122	-1	215	198	-17	222	205	-17	222	212	-10
71	127	126	-1	221	204	-17	228	211	-17	228	218	-10
72	131	130	-1	227	210	-17	234	217	-17	234	224	-10
73	135	133	-2	233	216	-17	241	223	-18	241	231	-10
74	139	137	-2	240	221	-19	248	229	-19	248	237	-11
75	143	141	-2	246	228	-18	254	236	-18	254	244	-10
76	147	144	-3	253	234	-19	261	242	-19	261	250	-11
77	151	148	-3	260	240	-20	268	248	-20	268	257	-11
78	153	152	-1	267	246	-19	275	255	-20	275	263	-12
79	159	156	-3	273	252	-21	282	261	-21	282	270	-12
80	166	160	-6	280	259	-21	289	268	-21	289	277	-12

Table 22a (Continued)

Comparison of Current AR 40-501 and Revised Height and Weight Standards
(in Pounds, with Maximum Weight Set at 120 Percent of Mean Body-Mass)

Males

Maximum									
31-35 yrs			36-40 yrs			41 yrs and over			Height (Inches)
AR 40-501	120% BM	Change	AR 40-501	120% BM	Change	AR 40-501	120% BM	Change	
-	150	-	-	150	-	-	150	-	58
-	155	-	-	155	-	-	155	-	59
162	161	-1	157	161	+4	150	161	+11	60
167	166	-1	162	166	+4	155	166	+11	61
173	172	-1	168	172	+4	160	172	+12	62
178	177	-1	173	177	+4	165	177	+12	63
184	183	-1	179	183	+4	171	183	+12	64
190	189	-1	184	189	+5	176	189	+13	65
196	195	-1	190	195	+5	182	195	+13	66
202	201	-1	196	201	+5	187	201	+14	67
208	207	-1	202	207	+5	193	207	+14	68
214	213	-1	208	213	+5	198	213	+15	69
220	219	-1	214	219	+5	204	219	+15	70
227	225	-2	220	225	+5	210	225	+15	71
233	232	-1	226	232	+6	216	232	+16	72
240	238	-2	233	238	+5	222	238	+16	73
246	245	-1	239	245	+6	228	245	+17	74
253	252	-1	246	252	+6	234	252	+18	75
260	258	-2	252	258	+6	241	258	+17	76
266	265	-1	259	265	+6	247	265	+18	77
273	272	-1	266	272	+6	254	272	+18	78
281	279	-2	273	279	+6	260	279	+19	79
288	286	-2	279	286	+7	267	286	+19	80

decrease of 1 or 2 pounds for the 31-35 year-old males and an increase of 4 to 7 pounds for males, aged 36-40 years. (As was the case in presenting the revised standards set at 135 percent of mean body-mass converted to pounds (Tables 20a and 20b), the standards for the 41 years and over age bracket under the 120 percent of mean body-mass standards were calculated for the NHANES II males and females, aged 41-45 years-old. The standards are the same as those for the 31-35 years-old and 36-40 years-old males and 36-40 years-old females.)

Table 22b presents the comparison of the current AR 40-501 height and weight standards and revised standards using a 120 percent mean body-mass standard for females. For those females aged 16-20 years and 21-25 years, Table 22b shows that the maximum allowable weight is increased by 13 to 26 pounds, depending on age and height. This compares to increases of 31 to 45 pounds under the 135 percent mean body-mass standard shown in Table 20b. Application of the 120 percent mean body-mass standard results in increases in the maximum allowable weight of 17 to 30 pounds for older females, 26-30 years, 31-35 years, and 36-40 years, compared to increases of 37 to 57 pounds shown in Table 20b.

Table 23 summarizes the percentages of males and females who would qualify for enlistment under the 135 percent mean body-mass standards but who would be disqualified under the 120 percent mean body-mass standard. Among 16-24 year-olds, 3.8 percent of the NLS males and 4.1 percent of the NLS females are moved from the qualified category to the overweight and not qualified category. The comparable percentages for NHANES I males and females, aged 16-24 years, are 5.3 percent and 4.6 percent, respectively,

and for the NHANES II males and females, 4.0 percent and 5.7 percent, respectively. Among all the males and females aged 16-40 years in the NHANES I sample, the percentages becoming not qualified are 5.1 percent and 6.3 percent, respectively. The comparable percentages for the NHANES II males and females are 4.8 percent and 7.1 percent, respectively.

Tables 24a and 24b present the percentages in each of the three data sets who are qualified under the 120 percent mean body-mass standard for maximum allowable weight, as well as the proposed revised minimum weight and height standards, for 16-24 year olds and 16-40 year olds, respectively. As was the case in earlier analyses, the females are qualified at a lower rate than males, and black females are qualified at a lower rate than white and Hispanic females.

A detailed analysis of the percentage of the males and females in each data set who are overweight under the 120 percent mean body-mass standard, by age bracket and race/ethnic group, is presented in Table 25. Among the males in the NHANES I and NHANES II samples, marginally larger percentages of 25-30 year-old, 31-35 year-old, and 36-40 year-old males are disqualified for overweightedness compared to the 16-24 years-old. For females, a similar contrast is evident but with moderately larger differences.

The net effect of all the proposed revisions in the height and weight standards for 16-24 year-olds are presented in Tables 26a, 26b, and 26c. These tables are similar to those presented earlier (Tables 17a

Table 22b

Comparison of Current AR 40-501 and Revised Height and Weight Standards
(in Pounds, with Maximum Weight Set at 120 Percent of Mean Body-Mass)

Females

Height (Inches)	Minimum			Maximum								
				16-20 yrs			21-24 yrs			25-30 yrs		
	AR 40-501	80% BM	Change	AR 40-501	120% BM	Change	AR 40-501	120% BM	Change	AR 40-501	120% BM	Change
58	90	85	-5	120	136	+16	124	139	+15	126	143	+17
59	92	87	-5	122	139	+17	126	143	+17	128	147	+19
60	94	90	-4	124	143	+19	128	147	+19	130	151	+21
61	96	92	-4	127	146	+19	130	150	+20	132	155	+23
62	98	94	-4	128	150	+22	132	154	+22	134	159	+25
63	100	96	-4	132	153	+21	134	158	+24	136	162	+26
64	102	99	-3	135	157	+22	136	162	+26	139	166	+27
65	104	101	-3	138	161	+23	140	166	+26	144	170	+26
66	106	103	-3	141	165	+24	145	169	+24	148	174	+26
67	109	106	-3	145	168	+23	149	173	+24	152	178	+26
68	112	108	-4	150	172	+22	153	177	+24	156	182	+26
69	115	110	-5	154	176	+22	157	181	+24	161	186	+25
70	118	113	-5	158	180	+22	162	185	+23	165	190	+25
71	122	115	-7	162	184	+22	166	189	+23	169	194	+25
72	125	118	-7	167	188	+21	171	193	+22	174	199	+25
73	128	120	-8	171	192	+21	177	197	+20	179	203	+24
74	130	123	-7	175	195	+20	182	201	+19	185	207	+22
75	133	125	-8	179	199	+20	187	205	+18	190	211	+21
76	136	128	-8	184	203	+19	192	209	+17	196	215	+19
77	139	130	-9	188	208	+20	197	214	+17	201	220	+19
78	141	133	-8	192	212	+20	203	218	+15	206	224	+18
79	144	135	-9	196	216	+20	208	222	+14	211	228	+17
80	147	138	-9	201	220	+19	213	226	+13	216	233	+17

Table 22b (Continued)

Comparison of Current AR 40-501 and Revised Height and Weight Standards
(in Pounds, with Maximum Weight Set at 120 Percent of Mean Body-Mass)

Females

Maximum									
31-35 yrs			36-40 yrs			41 yrs and over			Height (Inches)
AR 40-501	120% BM	Change	AR 40-501	120% BM	Change	AR 40-501	120% BM	Change	
129	147	+18	132	151	+19	135	151	+16	58
131	151	+20	134	155	+21	137	155	+18	59
133	155	+22	136	159	+23	139	159	+20	60
135	159	+24	139	163	+24	141	163	+22	61
137	163	+26	140	167	+27	144	167	+23	62
139	167	+28	143	171	+28	145	171	+26	63
143	171	+28	145	175	+30	149	175	+26	64
148	175	+27	150	180	+30	153	180	+27	65
151	179	+28	154	184	+30	157	184	+27	66
156	183	+27	158	188	+30	162	188	+26	67
160	187	+27	162	192	+30	166	192	+26	68
164	191	+27	167	196	+29	170	196	+26	69
168	196	+26	171	201	+30	174	201	+27	70
173	200	+27	175	205	+30	179	205	+26	71
178	204	+26	181	209	+28	184	209	+25	72
183	208	+25	186	214	+28	190	214	+24	73
188	213	+25	191	218	+27	195	218	+23	74
194	217	+23	196	223	+27	200	223	+23	75
199	221	+22	202	227	+25	205	227	+22	76
204	226	+22	207	232	+25	211	232	+21	77
209	230	+21	213	236	+23	216	236	+20	78
215	234	+19	218	241	+23	220	241	+21	79
219	239	+20	223	245	+22	225	245	+20	80

Table 23

Percentage of Males and Females Qualified
Under 135 Percent Mean Body-Mass Standards
but Not Qualified
Under 120 percent Mean Body-Mass Maximum Weight Standards

	<u>Males</u>	<u>Females</u>
<u>NLS</u>		
16-20	4.3	3.9
21-24	<u>4.4</u>	<u>4.5</u>
16-24	<u>3.8</u>	<u>4.1</u>
<u>NHANES I</u>		
16-20	5.4	4.6
21-24	<u>5.0</u>	<u>4.6</u>
16-24	5.3	4.6
25-30	4.5	7.7
31-35	5.4	6.6
36-40	<u>5.2</u>	<u>8.8</u>
Total	<u>5.1</u>	<u>6.3</u>
<u>NHANES II</u>		
16-20	3.1	5.1
21-24	<u>5.3</u>	<u>6.4</u>
16-24	4.0	5.7
25-30	4.7	8.3
31-35	5.3	8.0
36-40	<u>7.3</u>	<u>8.0</u>
Total	<u>4.8</u>	<u>7.1</u>

Table 24a

Percentage Qualified and Not Qualified
Under Revised Height and Weight Standards
(with Maximum Weight Set at 120 Percent Mean Body-Mass)

16-24 Year-old Males and Females

	Males				Females			
	White	Black	Hispanic	Total	White	Black	Hispanic	Total
NLS								
Qualified	92.8	93.7	91.3	92.9	91.4	85.9	91.9	90.8
Not Qualified:								
Underheight	0.0	0.0	0.0	0.0	0.3	1.4	1.1	0.5
Overheight	0.0	0.3	0.0	0.1	0.0	0.0	0.0	0.0
Underweight	1.2	1.6	1.9	1.2	1.4	1.3	1.4	1.5
Overweight	6.0	4.3	6.8	5.8	6.8	11.5	5.7	7.3
	7.2	6.3	8.7	7.1	8.6	14.1	8.1	9.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NHANES I								
Qualified	90.0	90.5	92.1	90.2	87.3	79.2	86.6	86.3
Not Qualified:								
Underheight	0.0	0.0	0.0	0.0	0.4	0.5	4.3	0.6
Overheight	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Underweight	2.0	3.2	0.0	2.0	3.0	2.6	4.1	3.0
Overweight	8.0	6.3	7.9	7.8	9.3	17.7	5.0	10.1
	10.0	9.5	7.9	9.8	12.7	20.8	13.4	13.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NHANES II								
Qualified	92.4	92.5	80.9	91.7	88.5	80.6	84.4	87.2
Not Qualified:								
Underheight	0.0	0.0	0.0	0.0	0.4	0.4	3.7	0.6
Overheight	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Underweight	1.5	1.4	0.6	1.4	1.2	1.3	2.3	1.3
Overweight	6.2	6.1	18.5	6.9	9.9	17.7	9.7	10.9
	7.6	7.5	19.1	8.3	11.5	19.4	15.6	12.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 24b
Percentage Qualified and Not Qualified
Under Revised Height and Weight Standards
(with Maximum Weight Set at 120 Percent Mean Body-Mass)

16-40 Year-old Males and Females

	Males				Females			
	White	Black	Hispanic	Total	White	Black	Hispanic	Total
NHANES I								
Qualified	91.0	88.8	93.6	90.9	86.4	74.8	83.1	84.9
Not Qualified:								
Underheight	0.0	0.0	0.0	0.0	0.4	0.4	3.5	0.5
Overheight	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Underweight	1.2	2.5	0.0	1.3	1.8	2.3	2.2	1.9
Overweight	7.8	8.7	6.4	7.8	11.4	22.5	11.2	12.8
	9.0	11.2	6.4	9.1	13.6	25.2	16.9	15.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NHANES II								
Qualified	92.3	90.7	84.8	91.7	86.2	74.8	76.7	84.2
Not Qualified:								
Underheight	0.0	0.0	0.0	0.0	0.2	0.2	5.2	0.5
Overheight	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Underweight	0.8	0.7	0.3	0.7	1.0	0.9	2.6	1.1
Overweight	7.0	8.6	14.9	7.6	12.6	24.1	15.5	14.2
	7.7	9.3	15.2	8.3	13.8	25.2	23.3	15.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 25

Percentage Overweight Under Revised Weight Standards
(with Maximum Weight Set at 120% Mean Body-Mass)

	Males				Females			
	White	Black	Hispanic	Total	White	Black	Hispanic	Total
NLS								
16-20	5.4	3.8	7.5	5.2	6.8	10.6	4.4	6.5
21-24	6.8	5.2	5.5	6.6	6.8	12.9	7.9	8.6
16-24	6.0	4.3	6.8	5.8	6.8	11.5	5.7	7.3
NIHANS I								
16-20	8.1	6.1	5.2	7.8	9.4	15.0	2.9	9.7
21-24	7.7	6.5	10.6	7.8	9.2	21.2	7.5	10.5
16-24	8.0	6.3	7.9	7.8	9.3	17.7	5.0	10.1
25-30	8.3	12.4	8.6	8.6	12.2	22.0	28.9	14.0
31-35	8.8	3.6	3.4	8.0	12.5	30.5	16.8	14.7
36-40	5.4	19.5	1.4	6.3	15.4	29.2	7.0	16.6
Total	7.8	8.7	6.4	7.8	11.4	22.5	11.2	12.8
NIHANS II								
16-20	4.8	6.6	24.2	6.1	9.3	13.5	11.3	9.9
21-24	8.0	5.5	12.3	8.0	10.8	23.4	8.1	12.2
16-24	6.2	6.1	18.5	6.9	9.9	17.7	9.7	10.9
25-30	7.0	11.3	11.0	7.6	13.1	29.3	15.9	15.4
31-35	7.5	10.1	2.5	7.5	18.5	26.5	45.2	18.5
36-40	8.5	11.7	20.8	9.7	14.6	32.7	8.1	16.5
Total	7.0	8.6	14.9	7.6	13.8	24.1	15.5	14.2

Table 76a

Summary of the Effect of Changes in AR 40-501 Weight and Height Standards
(Including the Effect of 100 percent vs. 120 percent Mean Body-mass Maximum Weight Standards)

16-24 Year-old Males and Females

NLS Sample

	Males					Females				
	Qualified	Not Qualified			Qualified	Not Qualified			Qualified	Not Qualified
		Height		Weight		Height		Weight		
	Total	Under	Over		Total	Under	Over		Under	Over
Current AR 40-501 Standards Conversion to Body-mass	95.9 (1.1)	0.1 -	0.1 -	1.3 (0.2)	2.7 (0.7)	0.5 -	0.5 -	0.1 -	1.0 (0.2)	22.0 (1.5)
Current AR 40-501 in Body-mass Revision to 115% of Mean Body-mass Adjustment to 120% of Mean Body-mass	98.6 (1.8)	0.1 -	0.1 -	1.1 -	2.0 (4.1)	0.5 -	0.5 -	0.1 -	1.9 -	20.6 (4.1)
Net Revision to 120% of Mean Body-mass	3.8 -	-	-	-	3.8 -	-	-	-	-	3.1 -
Revised Maximum Weight Standards Revision of Minimum Weight Standards	93.0 (0.2)	0.1 -	0.1 -	1.1 (0.1)	5.8 -	0.5 -	0.5 -	0.1 -	1.9 (0.4)	1.0 -
Revised Minimum and Maximum Weight Standards Revision of Height Standards	90.8 (0.1)	0.1 (0.1)	0.1 0.0	1.2 (0.0)	5.8 0.0	0.5 0.0	0.5 0.0	0.1 (0.1)	1.5 (0.0)	2.5 -
Revised Weight and Height Standards	92.9 -	0.0 -	0.1 -	1.2 -	5.8 -	0.5 -	0.5 -	0.0 -	1.5 -	1.5 -
Net Effect of All Revisions	3.0 (1.8)	(0.1) 0.0	0.0 -	(0.1) -	3.1 -	0.0 -	0.0 -	(0.1) -	1.0 -	14.1 -

Figure 1. The effect of the concentration of the *Agrobacterium* suspension on the transformation efficiency of *Agrobacterium* strains.

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Test	Mean	SD	SE	95% CI	99% CI	99.9% CI	99.99% CI	99.999% CI
Current AP 40-50: Standard Revision to 100 of Mean Body Mass Adjustment to Body-mass	94.4	1.1	0.1	94.2	94.6	94.9	95.2	95.5
Current AP 40-50: in Body-mass Revision to 100 of Mean Body Mass Adjustment to 100 of Mean Body Mass	94.4	1.1	0.1	94.2	94.6	94.9	95.2	95.5
Net Revision to 100 of Mean Body Mass	94.4	1.1	0.1	94.2	94.6	94.9	95.2	95.5
Revised Maximum Weight Standards Revision of Minimum Weight Standards	94.4	1.1	0.1	94.2	94.6	94.9	95.2	95.5
Revised Minimum and Maximum Weight Standards Revision of Health Standards	94.4	1.1	0.1	94.2	94.6	94.9	95.2	95.5
Revised Weight and Health Standards	94.4	1.1	0.1	94.2	94.6	94.9	95.2	95.5
Net Effect of All Revisions	94.4	1.1	0.1	94.2	94.6	94.9	95.2	95.5

and a 10% increase in the probability of being employed. The results are consistent with the hypothesis that the minimum wage has a small positive effect on employment.

1. The first step is to identify the problem or question that needs to be addressed. This involves understanding the context and the specific requirements of the task.

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	Qualified				Not Qualified			
	Height	Weight	Height	Weight	Height	Weight	Height	Weight
Current AP 40-501 Standards Conversion to Body Tags	45.3 (9.6)	4.1 (8.6)	0.1 (0.0)	1.6 (3.3)	17.8 (4.3)	0.2 (0.2)	0.6 (1.3)	2.9 (6.3)
Current AP 40-501 in Body Mass Revision to 110 of Mean Body Mass Adjustment to 120 of Mean Body Mass	45.3 (9.6)	4.1 (8.6)	0.1 (0.0)	1.6 (3.3)	17.8 (4.3)	0.2 (0.2)	0.6 (1.3)	2.9 (6.3)
Net Revision to 120 of Mean Body Mass	4.0	4.0	-	4.0	14.0	-	-	14.0
Revised Maximum Weight Standards Revision of Minimum Weight Standards	91.9 (20.3)	8.1 (17.7)	0.0 (0.0)	1.0 (2.2)	46.5 (10.3)	0.2 (0.5)	0.6 (1.3)	16.9 (37.0)
Revised Minimum and Maximum Weight Standards Revision of Height Standards	91.6 (20.1)	8.4 (18.4)	0.0 (0.0)	1.4 (3.0)	47.0 (10.2)	0.2 (0.2)	0.6 (1.3)	16.9 (37.0)
Revised Weight and Height Standards	91.7 (20.2)	8.3 (18.3)	0.0 (0.0)	1.4 (3.0)	47.2 (10.3)	0.0 (0.0)	0.6 (1.3)	16.9 (37.0)
Net Effect of All Revisions	3.6	4.6	0.0	0.1	19.4	0.2	0.0	17.0

through 17c) but include the adjustment for the change in the formula for determining the maximum weight standard. For the NLS males, the total qualification rate decreases from 95.9 percent under current standards to 92.9 percent, a 3.0 percentage point decrease, while for the NLS females it increases from 74.4 percent to 90.8 percent, a 16.4 percentage point increase (see Table 26a).

For the 16-24 year-old males and females in the NHANES I sample (Table 26b), the total percentage of males qualified under the 120 percent mean body-mass standard (90.2 percent) is a net decrease of 4.2 percentage points from the total under current standards, while the total percentage of qualified females (86.3 percent) increased 20.9 percentage points. Among the NHANES II participants, aged 16-24 years (Table 26c), the total qualification rate for males under the 120 percent mean body-mass standard (91.7 percent) is 3.6 percentage points lower than under current standards. For the females the qualification rate increases 19.4 percentage points under the revised standards to 87.2 percent.

The effect of all the proposed revisions in the AR 40-501 standards, including setting the maximum allowable weight at 120 percent of mean body-mass for the 16-40 year old males and females are presented in Tables 27a and 27b, respectively. The net effect on the overall qualification rate of the revisions among the NHANES I sample is a decrease of 2.0 percentage points for the males and an increase of 20.4 percentage points for the females (Table 27a). Under the 120 percent mean body-mass standards, 90.9 percent of all males and 84.9 percent of all females are qualified.

Table 27a

Summary of the Effect of Changes in AR 40-501 Height and Weight Standards
(Including the Effect of 135 percent vs. 120 percent Mean Body-Mass Maximum Weight Standards)

16-40 Year-old Males and Females

NHANES I Sample

	Males					Females				
	Qualified	Not Qualified			Total	Qualified	Not Qualified			Total
		Under	Over	Weight			Under	Over	Weight	
Current AR 40-501 Standards Conversion to Body-mass	92.9 1.5	7.1 (1.5)	0.0 -	0.0 (0.2)	1.3 (1.3)	5.8 (1.3)	0.5 -	0.0 -	3.4 (1.1)	31.6 (2.6)
Current AR 40-501 in Body-mass Revision to 135% of Mean Body-mass Adjustment to 120% of Mean Body-mass	94.4 1.8 (5.1)	5.6 (1.8)	0.0 -	1.1 -	4.5 (1.8)	68.2 22.5 (6.3)	0.5 -	0.0 -	2.3 -	29.0 (22.5) 6.3
Net Revision to 120% of Mean Body-mass	(3.3)	3.3	-	-	3.3	16.2	-	-	-	(16.2)
Revised Maximum Weight Standards Revision of Minimum Weight Standards	91.1 (0.2)	8.9 0.2	0.0 -	1.1 0.2	7.8 -	84.4 0.5	0.5 -	0.0 -	2.3 (0.4)	12.8 -
Revised Minimum and Maximum Weight Standards Revision of Height Standards	90.9 0.0	9.1 0.0	0.0 0.0	1.3 0.0	7.8 0.0	84.9 0.0	0.5 0.0	0.0 0.0	1.9 0.0	12.8 0.0
Revised Weight and Height Standards	90.9	9.1	0.0	1.3	7.8	84.9	0.5	0.0	1.9	12.8
Net Effect of All Revisions	(2.0)	2.0	0.0	0.0	2.0	20.4	0.0	0.0	(1.5)	(18.8)

Among the NHANES II males and females, aged 16-40 years (Table 27b), 91.7 percent and 84.2 percent, respectively, are qualified under the 120 percent of mean body-mass standards. These percentages represent a 1.8 percentage point decrease among males in the total percentage qualified, compared to current AR 40-501 standards, and an increase of 20.3 percentage points among the females.

In sum, the removal of the analytic constraint, that the current AR 40-501 standards for young males, aged 16-24 years, not be modified, and setting the maximum allowable weight at 120 percent of the mean body-mass for all males and females, resolves the problems described earlier. The resultant tables of acceptable heights and weights are much more reasonable and the intent of AR 40-501, Paragraph 2-23d is not violated. Accordingly, the analyses indicate that the 120 percent mean body-mass standard is more appropriate in a revision of the AR 40-501 weight standards than the 135 percent mean body-mass standard.

Table 27b

Summary of the Effect of Changes in AR 40-501 Height and Weight Standards
(Including the Effect of 135 percent vs. 120 percent Mean Body-Mass Maximum Weight Standards)

16-40 Year-old Males and Females

NHANES II Sample

	Males						Females					
	Qualified			Not Qualified			Qualified			Not Qualified		
	Total	Under	Over	Height	Under	Over	Total	Under	Over	Height	Under	Over
Current AR 40-501 Standards Conversion to Body-mass	93.5 (1.3)	6.5 (1.3)	0.1 -	0.0 -	0.9 (0.4)	5.5 (0.9)	63.9 (3.8)	36.1 (3.8)	0.5 -	0.1 -	2.6 (1.1)	32.9 (2.7)
Current AR 40-501 in Body-mass Revision to 135% of Mean Body-mass Adjustment to 120% of Mean Body-mass	94.8 (1.8) (4.8)	5.2 (1.8) 4.8	0.1 - -	0.0 - -	0.5 - -	4.6 (1.8) 4.8	67.7 (23.1) (7.1)	32.3 (23.1) 7.1	0.5 - -	0.1 - -	1.5 - -	30.2 (23.1) 7.1
Net Revision to 120% of Mean Body-mass	(3.0)	3.0	-	-	-	3.0	(16.0)	(16.0)	-	-	-	(16.0)
Revised Maximum Weight Standards Revision of Minimum Weight Standards	91.8 (0.2)	8.2 (0.2)	0.1 -	0.0 -	0.5 (0.2)	7.6 -	83.7 (0.4)	16.3 (0.4)	0.5 -	0.1 -	1.5 (0.4)	14.2 -
Revised Minimum and Maximum Weight Standards Revision of Height Standards	91.8 (0.1)	8.4 (0.1)	0.1 (0.1)	0.0 0.0	0.7 0.0	7.6 0.0	94.1 (0.1)	15.9 (0.1)	0.5 0.0	0.1 (0.1)	1.1 0.0	14.2 0.0
Revised Weight and Height Standards	91.7	8.3	0.0	0.0	0.7	7.6	84.2	15.8	0.5	0.0	1.1	14.2
Net Effect of All Revisions	(1.8)	1.8	(0.1)	0.0	(0.2)	2.1	20.3	(20.3)	0.0	(0.1)	(1.5)	(18.7)

SECTION XI

Proposed Revised AR 40-501 Appendix III, Tables I and II

The net result of our analysis and proposals for revision of AR 40-501, Appendix III, Tables I and II are summarized in revised tables of militarily acceptable weight, in pounds (Tables 28a and 28b). These tables incorporate all the changes specified in Section IX, An Interim Summary, except for Proposal 4. Proposal 4, pertaining to the body-mass percentage, is modified so that a body-mass value of 120 percent of the mean body-mass for each age bracket is to be applied for all males and females as the maximum allowable weight. Tables 28a and 28b incorporate this revised proposal.

In addition to the revision of AR 40-501, Appendix III, Tables I and II, changes in the text of AR 40-501, Section XII, Height, Weight, and Body Build, Paragraph 2-21, Height, are required to effect the proposed changes in the height standards, if the proposed revisions are implemented. Currently, the text of Paragraph 2-21 states:

2-21. Height

The causes for rejection for appointment, enlistment, and induction are--

a. For appointment.

- (1) Men. Height below 60 inches or over 80 inches
(see administrative criteria in para 7-13).
- (2) Women. Height below 58 inches or over 72 inches.

Table 28a

Proposed Revision of
AR 40-501, Appendix III, Table I
Tables of Weight, Males

APPENDIX III
TABLES OF WEIGHT

Table I. Table of Militarily Acceptable Weight (in Pounds)
as Related to Age and Height for
Males--Initial Procurement

Height (inches)	Minimum (regardless of age)	Maximum					
		16-20 yrs	21-24 yrs	25-30 yrs	31-35 yrs	36-40 yrs	41 yrs and over
58.....	84	136	141	145	150	150	150
59.....	87	141	146	151	155	155	155
60.....	90	145	151	156	161	161	161
61.....	93	150	156	161	166	166	166
62.....	96	155	161	166	172	172	172
63.....	99	160	166	172	177	177	177
64.....	102	166	171	177	183	183	183
65.....	106	171	177	183	189	189	189
66.....	109	176	182	188	195	195	195
67.....	112	181	188	194	201	201	201
68.....	116	187	194	200	207	207	207
69.....	119	192	199	206	213	213	213
70.....	122	198	205	212	219	219	219
71.....	126	204	211	218	225	225	225
72.....	130	210	217	224	232	232	232
73.....	133	216	223	231	238	238	238
74.....	137	221	229	237	245	245	245
75.....	141	228	236	244	252	252	252
76.....	144	234	242	250	258	258	258
77.....	148	240	248	257	265	265	265
78.....	152	246	255	263	272	272	272
79.....	156	252	261	270	279	279	279
80.....	160	259	268	277	286	286	286

Table 28b

Proposed Revision of
AR 40-501, Appendix III, Table II
Tables of Weight, Females

APPENDIX III
TABLES OF WEIGHT

Table II. Table of Militarily Acceptable Weight (in Pounds)
as Related to Age and Height for
Females--Initial Procurement

Height (inches)	Minimum (regardless of age)	Maximum					
		16-20 yrs	21-24 yrs	25-30 yrs	31-35 yrs	36-40 yrs	41 yrs and over
58.....	85	136	139	143	147	151	151
59.....	87	139	143	147	151	155	155
60.....	90	143	147	151	155	159	159
61.....	92	146	150	155	159	163	163
62.....	94	150	154	159	163	167	144
63.....	96	153	158	162	167	171	171
64.....	99	157	162	166	171	175	175
65.....	101	161	166	170	175	180	180
66.....	103	165	169	174	179	184	184
67.....	106	168	173	178	183	188	188
68.....	108	172	177	182	187	192	192
69.....	110	176	181	186	191	196	196
70.....	113	180	185	190	196	201	201
71.....	115	184	189	194	200	205	205
72.....	118	188	193	199	204	209	209
73.....	120	192	197	203	208	214	214
74.....	123	195	201	207	213	218	218
75.....	125	199	205	211	217	223	223
76.....	128	203	209	215	221	227	227
77.....	130	208	214	220	226	232	232
78.....	133	212	218	224	230	236	236
79.....	135	216	222	228	234	241	241
80.....	138	220	226	233	239	245	245

b. For enlistments and induction.

- (1) Men. Height below 60 inches or over 80 inches for Army and Air Force.
- (2) Men. Height below 60 inches or over 78 inches for Navy and Marine Corps.
- (3) Women. Height below 58 inches or over 72 inches for Army.

In place of this text, the following text would be substituted:

2-21. Height

The causes for rejection for appointment, enlistment, and induction are height below 58 inches or over 80 inches (see administrative criteria in para 7-13).

The revised tables and text result in standards for males and females that are sex neutral, except for the fact that males weigh more than females when height and age are both controlled for. The methodology for establishing minimum and maximum weight standards is uniform and consistently applied regardless of sex. The minimum and maximum height standards for males and females are revised to be the same, reflecting the lack of medical justification for differentiating between very short or very tall males and females. In sum, these proposed revisions result in the elimination of the wide differences in male and female qualification rates that result when the current AR 40-501 height and weight standards are applied to nationally representative samples of Americans (see Tables 3a and 3b).

SECTION XII

Concluding Discussion

The analysis presented in this report has not directly addressed the issue of obesity in assessing and proposing revised weight standards. Commonly, obesity and overweight are considered to be the same thing, and the two terms are used interchangeably. In fact, they are two distinct measures. Overweight is simply an excess in total body weight (bone, muscle, soft tissue, and fat) relative to standards for height. Obesity, on the other hand, is an excess of body fat, expressed as a percentage of total body weight. Thus, overweight people are very frequently, but not necessarily, obese. Similarly, obese people are usually also overweight, but not necessarily so.

The assessments of the current AR 40-501 standards and revised standards at 135 percent and 120 percent of mean body-mass performed in the present analysis have all dealt with the issue of overweightedness and ignored the issue of obesity. There are several reasons for this. First, the operational realities of implementing screening procedures at Military Entrance Processing Stations (MEPSS) must be considered. In terms of expediency and efficiency, a method that objectively and reliably screens several hundreds of thousands of applicants each year must be implemented. Placing a person on a set of scales and measuring their height and then comparing the results to a table of standards meets the criteria of objectivity and efficiency.

While methods are available that permit measurement of body fat and the specification of standards in terms of obesity, these methods tend not to be reliable when applied on a large scale. One method that could be implemented as part of the screening process at the MEPSs is skin-fold measurements that are then converted into a measure of percentage of body fat to total weight. The problem with this method is that there is frequently large variation in the measures of skin fold obtained when measures of reliability are taken. Measurement of skin-fold requires precision in the specification of the measurement site and in the calibration of the calipers used to perform the measurement. Variation in an inch in the measurement site can result in large variations in the skin-fold measurement. The experience of the NHANES examination staff has been that reliable measures of skin-fold thickness are best obtained by having two independent sets of measurements taken and then comparing the two. Thus, to perform skin-fold screening of several hundreds of thousands of applicants each year at the MEPSs would likely be an onerous task.

The second reason for the specification of overweightedness as the screening criterion in our analysis is that, within the general population, the incidence of overweightedness is higher than that of obesity. Accordingly, overweightedness is a more stringent criterion than is obesity. In an analysis of NHANES I data, abstracted in Table 29 (National Center for Health Statistics, January, 1983) at the 85th or higher percentile, 23.2 percent of the males and 29.5 percent of the females were overweight, compared to 19.4 percent and 27.7 percent, respectively, who were obese. A cross-classification of the incidences of

Table 29

Percentage of NHANES I Population, Aged 20-74 Years
Overweight and/or Obese

85th Percentile or More^a

	Males			Females		
	Obese ^b	Not Obese	Total	Obese ^b	Not Obese	Total
Overweight	12.7	10.5	23.2	21.5	8.0	29.5
Not Overweight	6.6	80.1	76.8	6.1	75.3	70.5
Total	19.4	90.6	100.0	27.7	83.3	100.0

Cell percentages may not sum to marginal totals due to rounding.

a) Adapted from Table B and Table C, National Center for Health Statistics (January 1983).

b) As measured by the sum of triceps and subscapular skin-fold measurements.

obesity and overweightedness (see Table 29) showed that 10.5 percent of the males and 8.0 percent of the females were overweight but not obese. In contrast, 6.6 percent of the males and 6.1 percent of the females were obese but not overweight. As is apparent, selection of either obesity or overweight as the screening criterion inevitably results in some people being accepted into the military who ought not be. However, using overweight as the screening criterion results in fewer obese people being accepted than would be the case if obesity were the screening criterion. Thus, the overweight criterion is a more conservative one than is obesity. Further, those individuals who are obese, but not overweight, result in fewer "exceptional" cases who would have to be handled by AR 40-501, Paragraph 2-23d, Obesity (see Section IX). As currently written, AR 40-501 can handle individuals who are obese but not overweight. If the regulation were to screen individuals using measures of obesity it would be difficult, in the absence of objective standards of overweightedness, to handle individuals who were not obese but overweight. In this respect, using overweight as the screening criterion is more parsimonious, in that only one set of standards are required.

The third, and final reason for the use of overweightedness, rather than obesity, as the screening criterion, is the existence of weight control procedures and policies applicable to those already in the military. Department of Defense Directive 1308.1, Physical Fitness and Weight Control Programs, includes weight control standards and directs the Military Services to implement weight control programs. DoD policy, under Directive 1308.1, specifies the determining factor in deciding whether a service member is overweight is the member's percent of body fat. Thus,

it is DoD's policy that the weight control program for those already in the military be aimed towards the control of obesity, as strictly defined. While an inevitable, but small, percentage of accessions into the military can be expected to be obese, despite the screening for overweightedness under AR 40-501, programs are in place to deal with this problem.

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APPENDIX

Methodological Issues

This appendix deals with three methodological issues having implications for the veracity of the analysis presented in this report and the proposed revised standards. The first issue concerns the comparability of the data sets used in the analysis and the data reported in the Build Study 1979. The Build Study 1979 is a widely recognized source of height and weight data of massive proportions, yet it was not considered suitable for use in the present analysis. The discussion below presents comparisons of Build Study 1979 and NHANES I and NHANES II body weight data and summarizes the reason for using the later data bases, rather than the former, in this report.

The second issue concerns the distributions of body weight and body-mass in terms of the standard normal distribution, the requirements of the analysis for normalcy, and the potential effect variations away from normalcy might have on the qualification rates under the proposed revised maximum weight standards. The discussion below presents comparisons of the actual distributions of body weight and body-mass standard scores to the standard normal distribution and assesses the direction of any potential error resulting from deviations from normalcy.

The third methodological issue concerns the construction of the body-mass index and, in particular, the use of different variations of the body-mass formula for males ($BM=W/H^2$) and for females ($BM=W/H^{1.5}$).

Comparison of Build Study 1979 and NHANES I and II Data Sets

In medical practice and in the life insurance industry body weight as a function of height is most commonly assessed by use of the 1983 Metropolitan Height and Weight Tables. These tables are very familiar to the general public by their presence in virtually every general medical practitioner's office. The body weights presented in these tables are derived from height and weight data reported in the Build Study 1979. This report is recognized by actuaries in the insurance industry as the definitive compilation of height and weight data for insured lives, containing data collected from insurance policies issued to 3,996,650 males and 592,509 females. Given the respect accorded these data, their use in the development of the most commonly used set of weight standards, and the massive size of the data base, it was considered appropriate to compare them to those used in the present analysis.

Presented in Tables A-1 and A-2 are comparisons of the mean body weights reported in the Build Study 1979 with those obtained from the NHANES I and NHANES II data sets. (Comparisons of data from the NLS data set are not presented since the limited age range of participants precludes a complete set of comparative data.) These tables present the mean body weight and standard deviations for males (Table A-1) and females (Table A-2) by the 17-19 year-old, 20-29 year-old, and 30-39 year-old age groupings broken down into five height categories as reported in the Build Study 1979. Each of the NHANES I and NHANES II means was statistically compared to the mean reported in the Build Study 1979 by calculating the confidence interval around each mean using the Students t ($\alpha=.05$, $n-1$)

Table A-1
Mean Body Weights and Standard Deviations of
Build Study 1979, NHANES I, and NHANES II Data Sets

Males

Height	Build Study 1979			NHANES I			NHANES II		
	Number	Mean	Standard Deviation	Number	Mean	Standard Deviation	Number	Mean	Standard Deviation
17-19 Year-olds:									
58-62 inches	255	130	23	1	137	-	6	122	26
63-66 inches	4,955	138	18	52	136	20	61	136	25
67-70 inches	28,521	154	20	230	154	26	262	150	26*
71-74 inches	24,842	169	23	146	169	29	140	165	25
75-79 inches	3,066	188	27	7	182	65	16	183	29
20-29 Year-olds:									
58-62 inches	2,318	144	27	4	130	38	7	133	27
63-66 inches	51,610	148	19	133	147	27	145	150	24
67-70 inches	369,601	164	20	487	164	27	633	163	26
71-74 inches	374,446	180	23	321	181	32	418	177	30
75-79 inches	48,641	200	26	39	204	39	58	203	32
30-39 Year-olds:									
58-62 inches	4,598	147	26	6	155	51	10	162	33
63-66 inches	107,869	153	18	107	156	24	115	152	28
67-70 inches	665,790	169	20	337	176	30*	443	173	29*
71-74 inches	602,853	185	22	199	189	29	280	188	27
75-79 inches	66,546	205	24	14	219	46	23	201	27

* Difference from the Build Study 1979 mean body weight is statistically significant ($p < .05$).

Table A-2
Mean Body Weights and Standard Deviations of
Build Study 1979, NHANES I, and NHANES II Data Sets

Females

Height	Build Study 1979			NHANES I			NHANES II		
	Number	Mean	Standard Deviation	Number	Mean	Standard Deviation	Number	Mean	Standard Deviation
17-19 Year-olds:									
58-62 inches	120	105	16	5	107	10	9	105	20
63-66 inches	3,860	116	17	91	120	26	98	124	24*
67-70 inches	10,192	128	18	271	132	28*	275	131	23
71-74 inches	3,342	141	19	65	135	29	79	142	27
75-79 inches	135	152	25	5	151	36	1	252	-
20-29 Year-olds:									
58-62 inches	495	107	19	31	113	25	19	108	29
63-66 inches	16,684	118	17	563	125	28	306	126	27
67-70 inches	50,107	129	18	1,297	135	30*	780	138	29*
71-74 inches	18,353	141	20	373	148	29*	249	147	29*
75-79 inches	1,024	161	26	15	167	38*	12	171	31*
30-39 Year-olds:									
58-62 inches	604	111	20	27	124	27*	8	134	27
63-66 inches	24,958	122	18	420	134	32*	246	136	31*
67-70 inches	69,357	133	19	961	146	35*	548	146	37*
71-74 inches	24,489	145	20	267	158	39*	182	157	33*
75-79 inches	1,366	163	27	12	148	28	2	153	40

* Difference from the Build Study 1979 mean body weight is statistically significant ($p < .05$).

test. In addition, the confidence intervals around the NHANES I and NHANES II means were compared with each other to determine if any differences between these two data sets were statistically significant. All statistically significant differences are indicated by an asterisk in Tables A-1 and A-2.

With only three exceptions, the mean body weight of the males for each age and height subgrouping of the NHANES I and NHANES II data sets were not statistically different from those reported in the Build Study 1979 (see Table A-1). In no case were the means of the NHANES I and NHANES II data sets significantly different from each other.

For the females (see Table A-2) the mean weights of the 17-19 year-olds in the NHANES I and NHANES II data sets were similar to those reported in the Build Study 1979. In contrast, the mean weights for the 20-29 year-old and 30-39 year-old sub-groups in the two NHANES data sets were generally different from those reported in the Build Study 1979. As was the case for males, none of the NHANES I and NHANES II means were significantly different from each other.

The fact that there were no statistically significant differences in mean weights between the two NHANES data sets suggests that the two data sets reliably describe the weight of the U.S. population aged 17-39 years, which is the population of interest in this report. Statistically, it is improbable that the two independent NHANES surveys, performed at two different times, would produce data that are not statistically different, if indeed there were actual differences in the U.S. population.

In contrast, the statistically significant differences found between the NHANES I and NHANES II data and the Build Study 1979 data, especially for females, suggests that population described by the Build Study 1979 data is different from the two NHANES data sets. Indeed, this is the case. The NHANES surveys were national probability samples of all Americans, aged 6 months through 74 years while the Build Study 1979 included only those people who had been issued individual insurance policies, a sample of Americans that is not statistically representative of the entire U.S. population.

Those Americans included in the Build Study 1979, commonly referred to as "insured lives", are generally older than those not included, that is, those Americans not carrying individual life insurance, are more affluent, and are predominantly male. The total number of males, aged 20-29 years, included in the Build Study 1979 was 846,931, while the total for males aged 30-39 years was 1,448,084. The comparable totals for females were 88,706 and 120,810. The difference in the number of male and female insured lives is a function of financial responsibility. Males are more frequently the head of household and thus more likely to obtain life insurance than are female non-heads of household. Among women as a group, those who are heads of households are more likely to carry individual life insurance than those who are not. Finally, most Americans are insured through employer sponsored group plans which are not included in the Build Study 1979. These plans cover the majority of all wage earners, most of whom earn less than the mean U.S. income, thus representing a less affluent group than those who carry individual life insurance.

This brief summary of who carries individual life insurance and thus is included in the Build Study 1979 clearly suggests that these data are not necessarily representative of the entire U.S. population. While these data are extremely useful for analyses of weight in terms of morbidity and mortality and as the basis for establishing standards of weight such as the 1983 Metropolitan Life Height and Weight Tables, they are less than ideal for use in establishing standards for enlistment into the military services which require representative data of all U.S. young people.

Accordingly, the differences in mean weights presented in Tables A-1 and A-3 between the Build Study 1979 and the two NHANES data sets are moot. The best set of data for use in the present analysis are the NHANES I and NHANES II data which are, to the best of our knowledge, the only comprehensive national probability samples of actual weight measurements available.

Comparison of Actual Body Weight and Body-Mass Distributions to the Standard Normal Distribution

To assess the distribution of actual body weights and body-mass index values the data for each NLS, NHANES I and NHANES II participant was converted to standard scores using the formula $Z=(X-\bar{X})/s$. Then, the number of participants whose standard score fell within each of ten equal segments of .5 standard normal deviations around the mid-point of 0 standard deviations was determined and statistically compared to the expected distribution of cases actually falling in each segment using the Chi-Square test ($\alpha=.01$, $df=9$). Finally, to facilitate presentation of the standard score distributions, the numerical counts falling in each of the ten segments of the standard normal distribution for each data set and age subgroup were converted to percentages. These data are presented in tabular form in Tables A-3 and A-4 and in graphic form in Figures A-1 through A-12.

As shown in Table A-3, which presents the distributions of body weights expressed in standards scores, all of the distributions were, compared to the standard normal distribution, statistically different. For both males and females in all age groupings, the actual percentages of standard scores falling between -1.96 and infinity were higher than the expected percentage of 2.50 percent. With only one exception (NHANES I males, aged 36-40 years) the actual percentages of standard scores falling between +1.50 and +1.96 and between +1.96 and infinity were lower than the expected percentages of 4.18 percent and 2.50 percent respectively.

Table A-4 presents the distributions of body-mass index values,

Table A-3
Distribution of Standard Scores of Body Weight into
Ten Equal Segments of the Standard Normal Distribution

Standard Deviations	Percentage of Cases Falling into Each Segment									
	2.50	4.18	9.19	14.98	19.15	25.39	31.25	37.41	43.75	50.00
Normal Distribution	2.50	4.18	9.19	14.98	19.15	25.39	31.25	37.41	43.75	50.00
NLS Survey:										
Males										
16-20 Years Old	3.54	4.04	4.46	12.54	22.37	18.11	22.29	10.04	1.86	0.76
21-24 Years Old	4.17	4.16	4.73	11.31	21.73	18.46	22.27	10.37	2.58	0.23
Females										
16-20 Years Old	4.38	2.53	2.86	13.31	19.33	25.39	23.75	7.41	0.95	0.09
21-24 Years Old	5.91	2.57	4.57	8.87	15.62	31.25	21.11	9.37	0.62	0.11
NHANES I:										
Males										
16-20 Years Old	3.83	3.20	5.65	11.76	19.41	25.47	18.53	10.75	1.42	0.00
21-24 Years Old	5.73	3.04	5.11	13.90	17.53	18.38	22.11	9.66	3.91	0.62
25-30 Years Old	4.07	2.17	6.17	11.35	19.35	21.85	23.41	9.46	2.18	0.00
31-35 Years Old	2.69	2.20	7.93	14.57	21.92	16.79	18.94	11.55	2.66	0.76
36-40 Years Old	4.00	2.13	4.55	16.04	22.91	21.01	16.06	8.01	4.73	0.55
Females										
16-20 Years Old	4.19	2.32	4.11	7.95	23.15	28.33	21.09	8.41	0.45	0.00
21-24 Years Old	4.14	2.17	4.11	9.93	22.28	25.60	23.89	7.44	0.37	0.06
25-30 Years Old	5.15	3.23	6.44	8.23	15.33	29.22	24.21	7.37	0.82	0.00
31-35 Years Old	4.52	2.38	5.49	8.01	16.42	30.40	27.26	5.53	0.00	0.00
36-40 Years Old	4.00	4.09	5.41	8.56	18.00	27.11	24.29	7.47	1.07	0.00
NHANES II:										
Males										
16-20 Years Old	4.49	3.19	4.81	10.90	20.88	22.85	21.15	0.70	1.62	0.41
21-24 Years Old	4.90	2.74	6.65	9.26	21.50	22.93	21.67	7.97	1.94	0.45
25-30 Years Old	3.99	2.29	5.76	11.39	23.34	22.50	19.37	9.02	2.27	0.08
31-35 Years Old	3.90	3.88	6.55	12.32	21.27	19.56	19.44	10.31	2.07	0.72
36-40 Years Old	3.31	3.36	8.17	9.74	23.71	22.56	14.97	8.73	4.00	1.46
Females										
16-20 Years Old	4.26	2.37	5.67	8.53	19.91	30.04	20.70	6.65	1.70	0.19
21-24 Years Old	3.61	3.45	4.00	10.68	18.23	27.88	24.96	6.29	0.90	0.00
25-30 Years Old	3.75	3.39	6.33	8.93	16.15	28.25	26.26	6.29	0.66	0.00
31-35 Years Old	5.81	2.99	6.08	7.15	14.57	31.81	22.40	8.96	0.23	0.00
36-40 Years Old	5.75	2.54	5.15	8.73	15.93	30.36	22.74	8.10	0.50	0.00

expressed in standard scores. The comparison of observed frequencies to expected frequencies using the Chi-square test resulted in the finding that all subgroups of males and females were statistically different from the standard normal distribution. As was the case for body weight (Table A-3), the actual percentages of standard scores falling between -1.96 and infinity were higher than the expected percentage of 2.50 percent for males and females in all age groupings. At the other extreme standard score bracket, +1.96 to infinity, the actual percentage of standard scores for males and females in all age brackets were lower than the expected percentage of 2.50 percent. In the standard score bracket of +1.50 to +1.96, all the actual percentages for females were lower than the 4.18 percent expected, while for males four of the ten age groupings contained larger than expected percentages.

The differences in the distributions of body weights and body-masses, expressed as standard scores, compared to the standard normal distribution are graphically presented in Figures A-1 through A-12. These figures present the tabular data contained in Tables A-3 and A-4 and are presented in age grouping order.

Regardless of sex or age, these figures consistently show that the actual distributions of standards scores at the left tail is higher than expected under the standard normal distribution while at the right tail it is lower. All the distributions are skewed towards the right tail and are leptokurtic with larger percentages of the standard scores falling in the center of the scale than at the tails. These characteristics are more pronounced for the females than for the males and visually confirm the

Table A-4
Distribution of Standard Scores of Body-mass into
Ten Equal Segments of the Standard Normal Distribution

Standard Deviations	Percentage of Cases Falling into Each Segment									
	0.00	-1.00	-1.50	-2.00	-2.50	-3.00	-3.50	-4.00	-4.50	-5.00
Normal Distribution	0.00	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00
Males										
16-20 Years Old	2.50	4.18	2.58	2.64	10.76	24.35	17.31	25.90	8.74	1.14
21-24 Years Old	4.14	4.49	3.53	3.32	12.38	23.32	14.88	25.91	10.05	0.99
Females										
16-20 Years Old	4.43	2.12	4.03	12.87	18.51	23.64	29.19	4.32	0.87	0.02
21-24 Years Old	6.46	2.27	2.94	11.40	12.88	36.32	19.51	7.29	0.80	0.12
Males										
16-20 Years Old	4.05	3.72	6.67	8.62	21.44	27.81	20.61	6.62	0.47	0.00
21-24 Years Old	3.76	4.02	6.23	21.06	12.67	14.71	19.51	11.42	4.60	0.00
25-30 Years Old	4.11	3.62	2.82	10.06	18.74	32.68	18.95	6.71	2.22	0.00
31-35 Years Old	2.85	2.95	6.40	12.89	20.28	18.09	19.57	11.36	4.52	1.09
36-40 Years Old	2.35	2.05	6.89	12.15	21.86	22.64	14.44	11.46	4.70	1.46
Females										
16-20 Years Old	4.29	2.61	2.83	7.59	17.44	29.14	29.93	5.78	0.39	0.00
21-24 Years Old	4.65	2.54	3.31	10.10	16.57	37.90	19.43	5.22	0.28	0.00
25-30 Years Old	5.44	5.44	2.80	4.78	17.11	29.25	23.94	7.76	0.74	0.00
31-35 Years Old	4.65	3.49	5.27	7.58	11.35	33.48	31.20	2.99	0.00	0.00
36-40 Years Old	4.27	3.40	7.02	6.28	15.95	27.64	28.60	6.50	0.16	0.00
Males										
16-20 Years Old	4.56	2.30	2.19	11.91	17.98	29.64	23.03	5.49	1.83	0.07
21-24 Years Old	3.52	4.45	6.00	14.89	14.79	21.31	21.20	11.61	2.03	0.20
25-30 Years Old	3.89	1.29	6.24	9.22	27.53	22.86	19.77	7.72	1.49	0.00
31-35 Years Old	3.64	3.83	5.63	13.43	18.64	23.84	17.30	10.31	3.08	0.29
36-40 Years Old	4.31	2.96	4.96	12.58	17.68	24.10	15.73	11.77	4.41	1.50
Females										
16-20 Years Old	4.92	2.24	5.06	6.25	21.00	33.77	17.48	8.59	0.70	0.00
21-24 Years Old	4.67	2.56	5.00	6.68	15.31	32.36	25.58	7.57	0.28	0.00
25-30 Years Old	4.19	3.87	4.53	10.16	15.64	30.53	24.97	6.11	0.00	0.00
31-35 Years Old	5.70	3.74	4.28	9.56	14.41	29.40	24.71	7.99	0.22	0.00
36-40 Years Old	5.41	2.08	6.15	8.03	13.71	30.56	21.34	11.10	0.62	0.00

Figure A-1

Comparison of the Distribution of Body Weight and Body-Mass
Standard Scores to the Standard Normal Distribution

NLS Survey Males and Females
16-20 Years Old

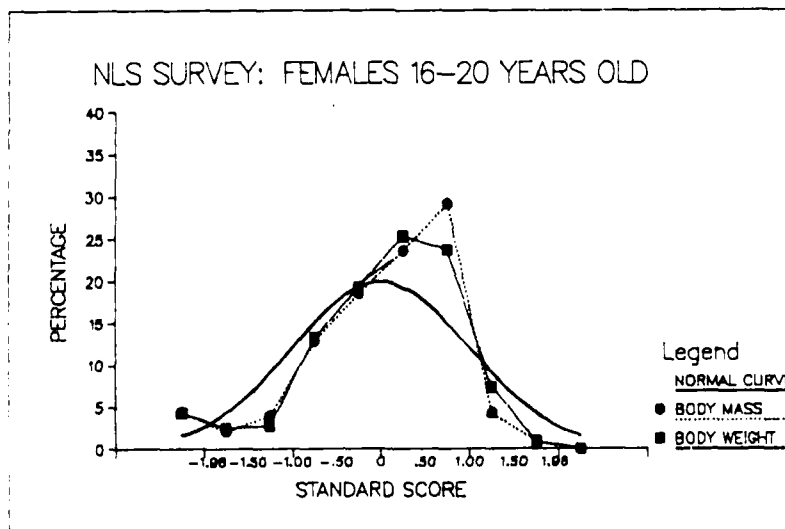
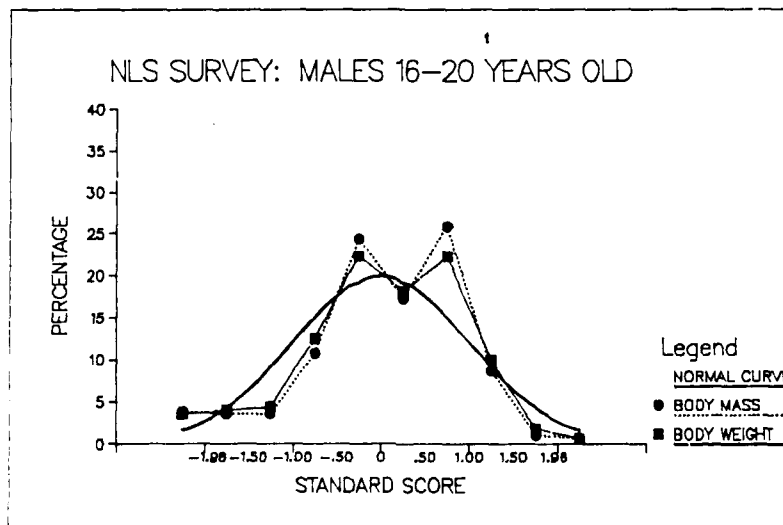


Figure A-2

Comparison of the Distribution of Body Weight and Body-Mass
Standard Scores to the Standard Normal Distribution

NHANES I Survey Males and Females
16-20 Years Old

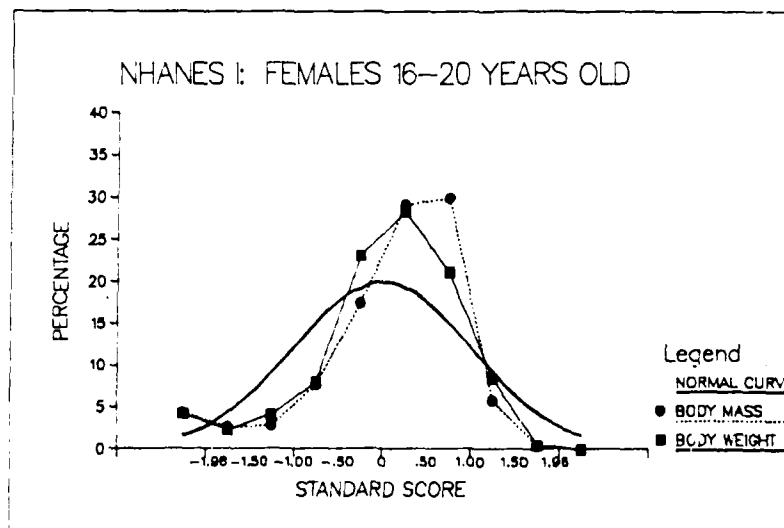
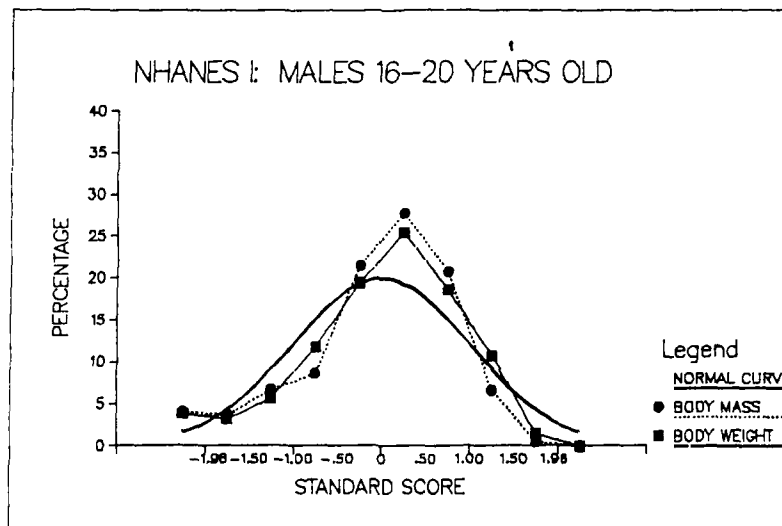


Figure A-3

Comparison of the Distribution of Body Weight and Body-Mass
Standard Scores to the Standard Normal Distribution

NHANES II Survey Males and Females
16-20 Years Old

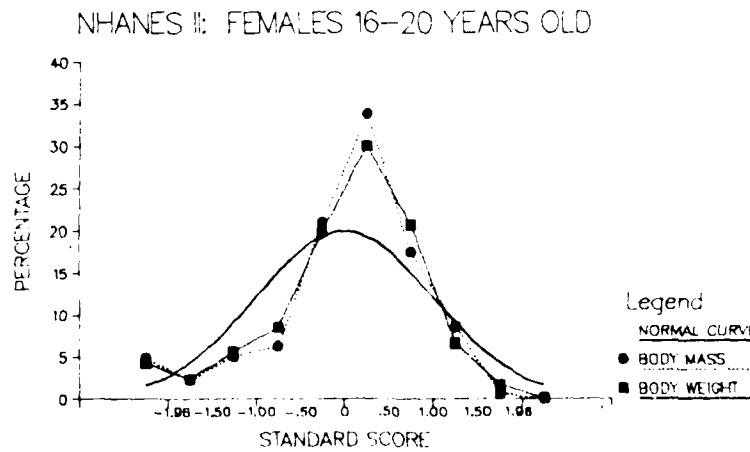
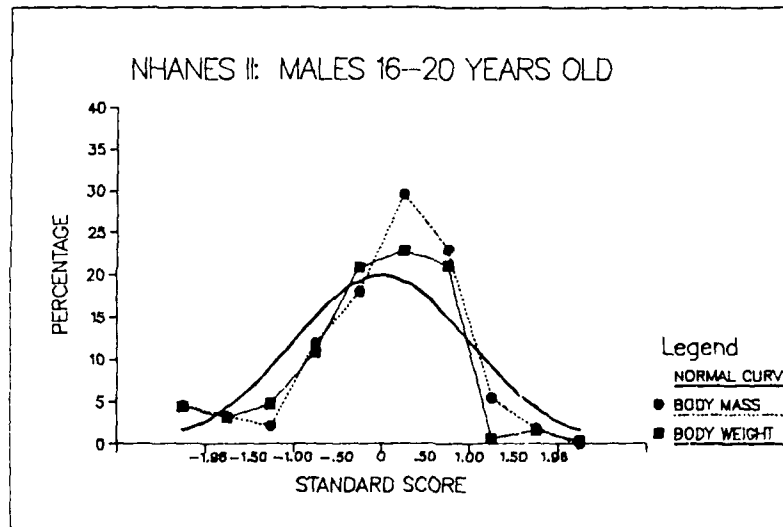


Figure A-4

Comparison of the Distribution of Body Weight and Body-Mass
Standard Scores to the Standard Normal Distribution

NLS Survey Males and Females
21-24 Years Old

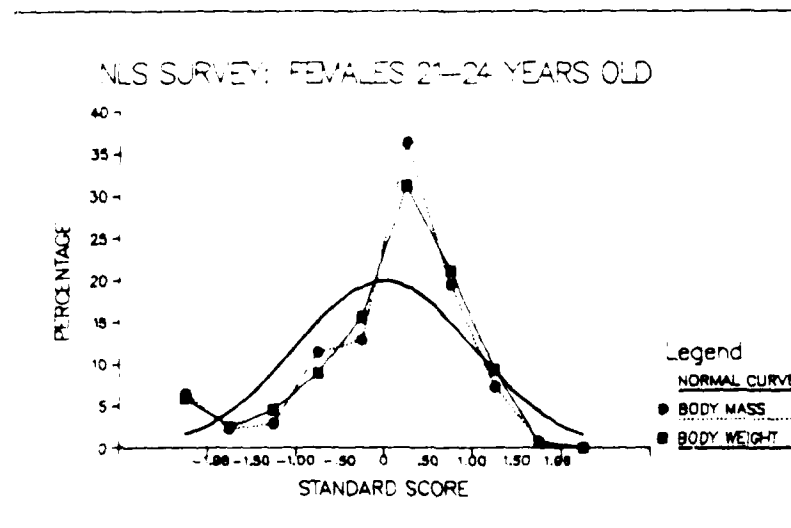
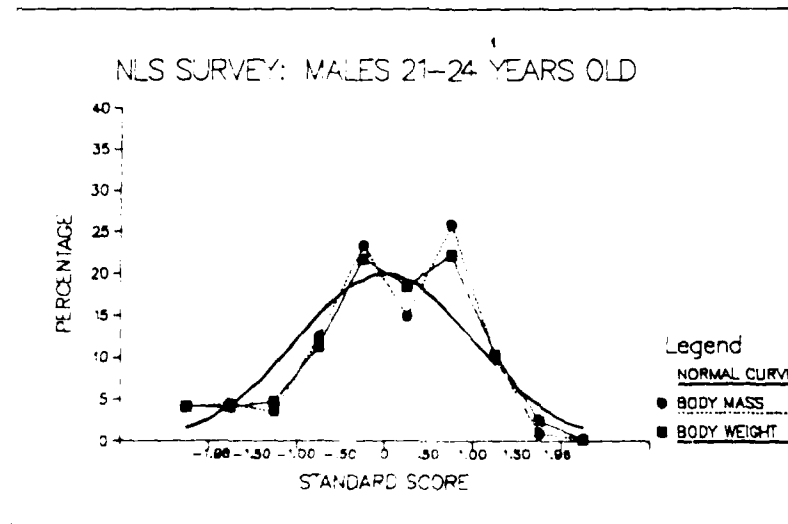


Figure A-5

Comparison of the Distribution of Body Weight and Body-Mass
Standard Scores to the Standard Normal Distribution

NHANES I Survey Males and Females
21-24 Years Old

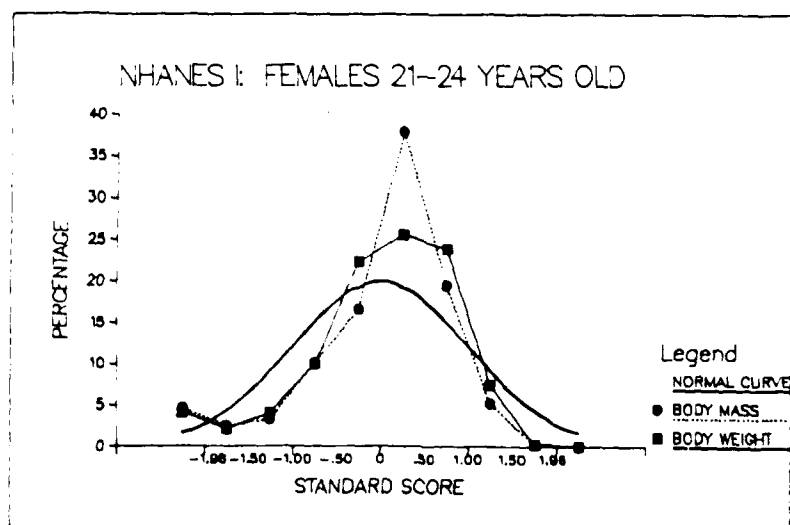
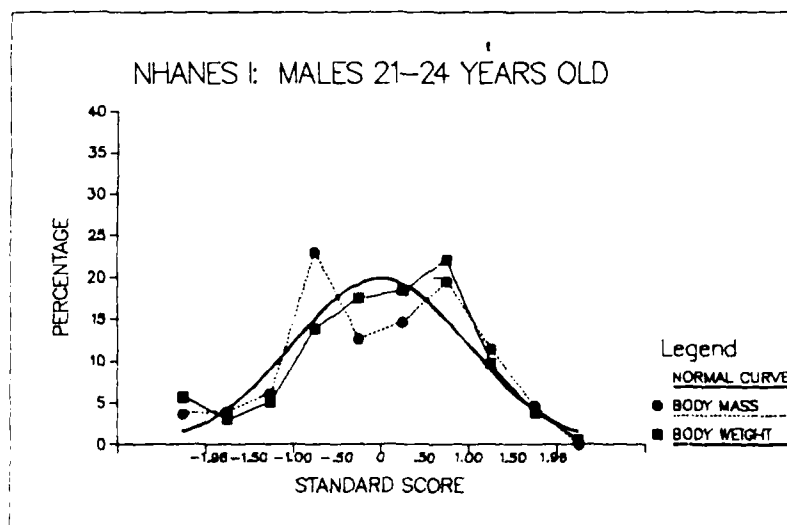


Figure A-6

Comparison of the Distribution of Body Weight and Body-Mass
Standard Scores to the Standard Normal Distribution

NHANES II Survey Males and Females
21-24 Years Old

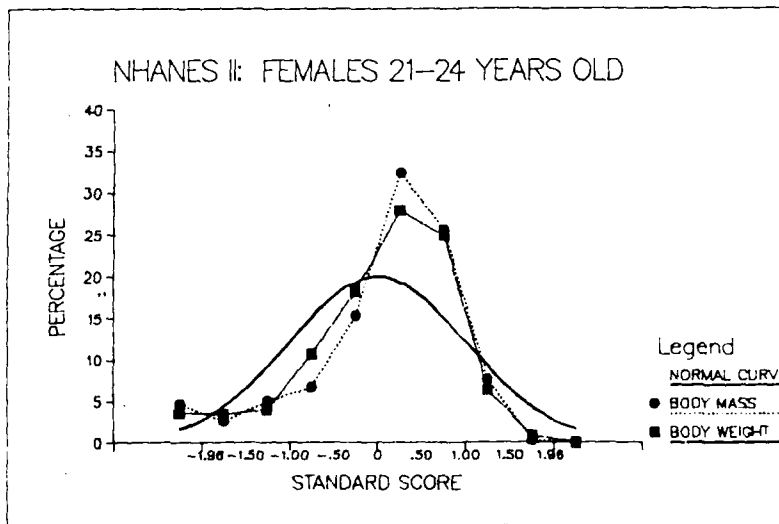
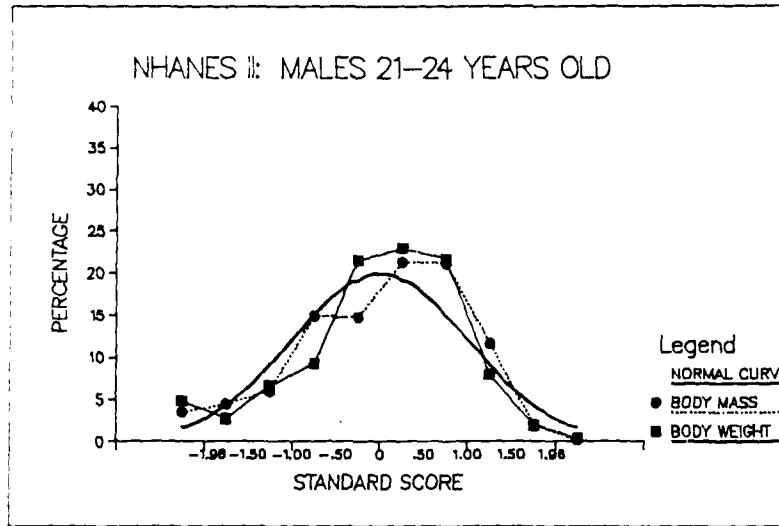


Figure A-7

Comparison of the Distribution of Body Weight and Body-Mass
Standard Scores to the Standard Normal Distribution

NHANES I Survey Males and Females
25-30 Years Old

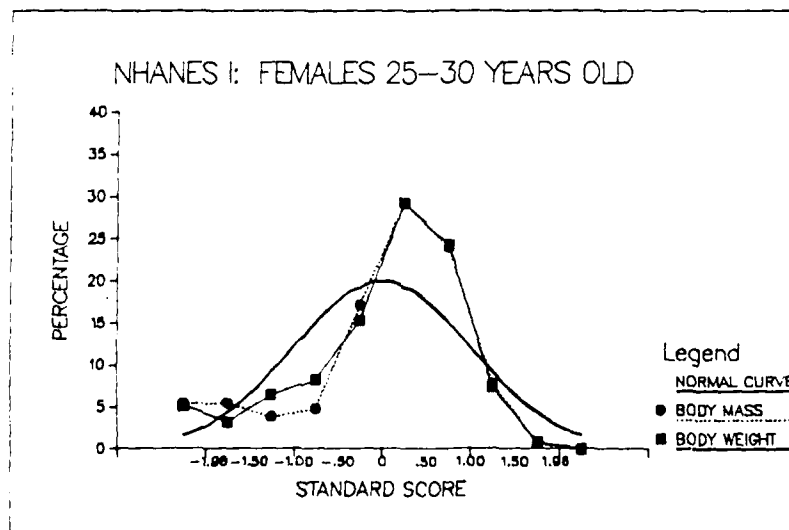
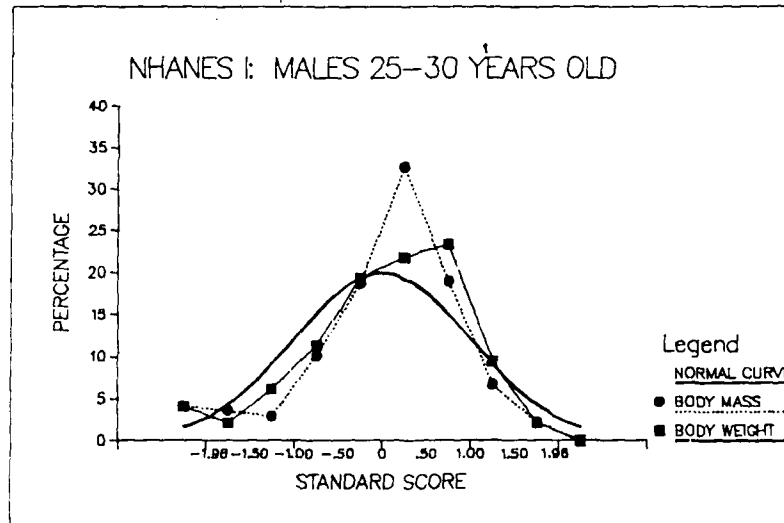


Figure A-8

Comparison of the Distribution of Body Weight and Body-Mass
Standard Scores to the Standard Normal Distribution

NHANES II Survey Males and Females
25-30 Years Old

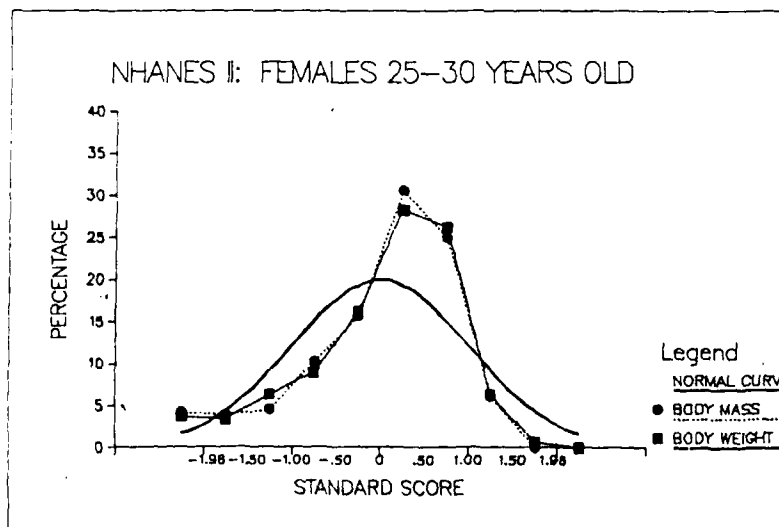
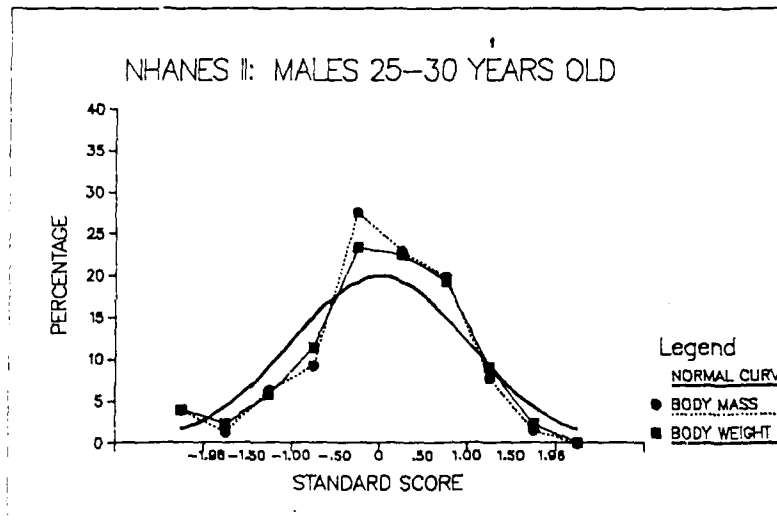


Figure A-9

Comparison of the Distribution of Body Weight and Body-Mass
Standard Scores to the Standard Normal Distribution

NHANES I Survey Males and Females
31-35 Years Old

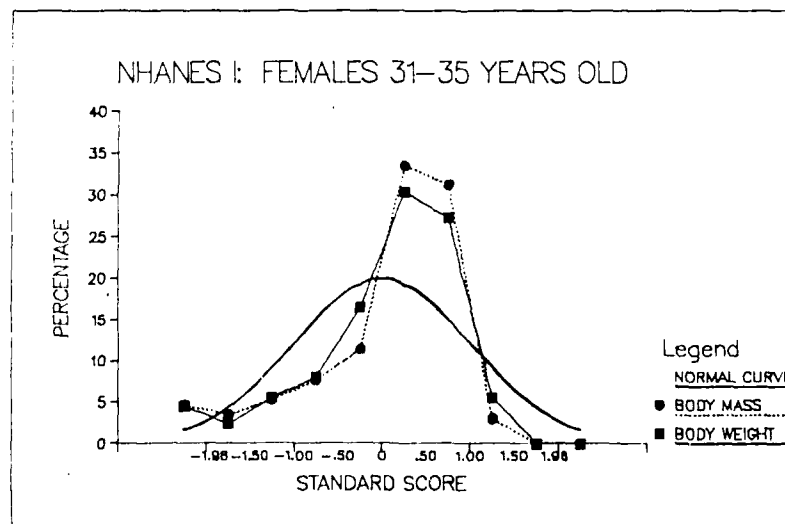
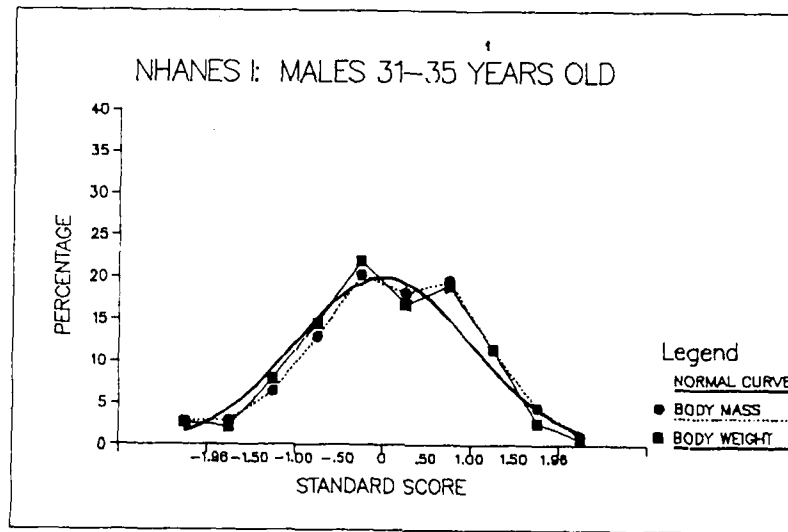


Figure A-10

Comparison of the Distribution of Body Weight and Body-Mass
Standard Scores to the Standard Normal Distribution

NHANES II Survey Males and Females
31-35 Years Old

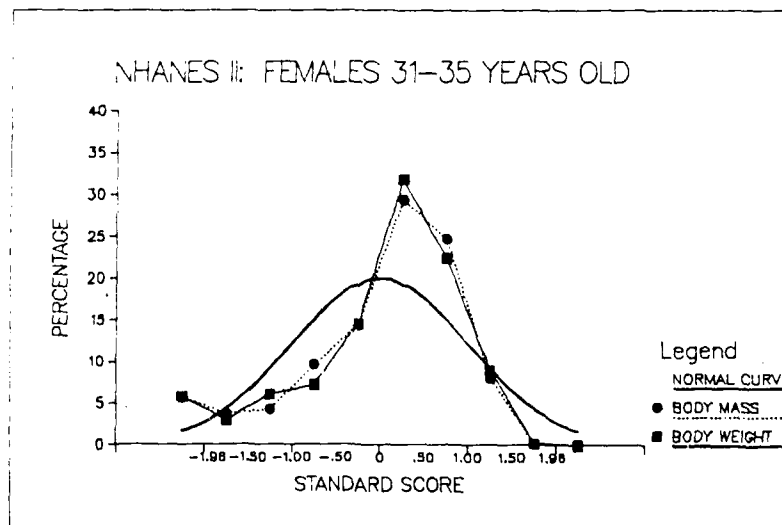
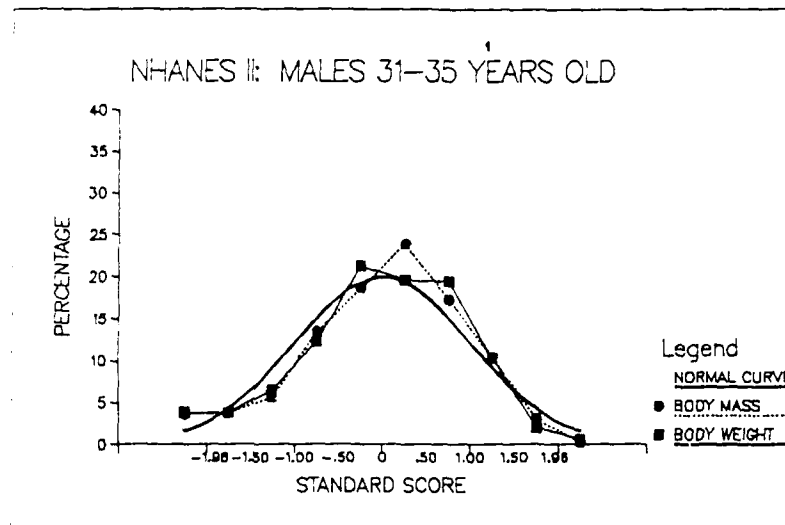


Figure A-11

Comparison of the Distribution of Body Weight and Body-Mass
Standard Scores to the Standard Normal Distribution

NHANES I Survey Males and Females
36-40 Years Old

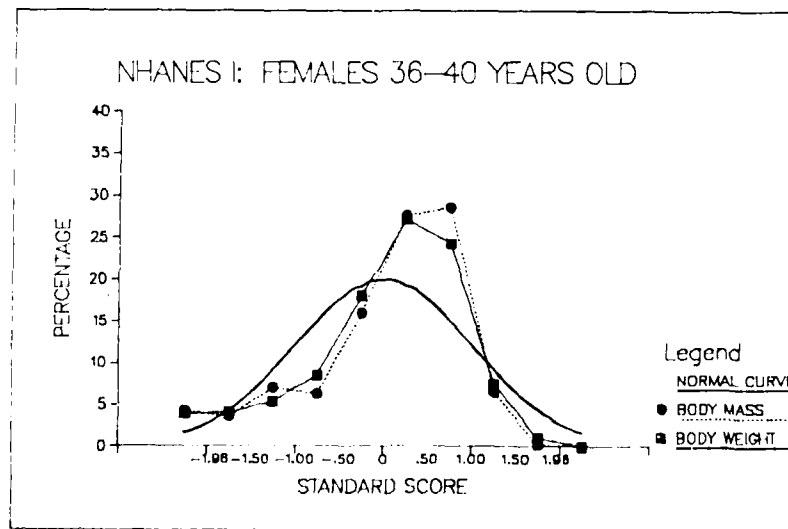
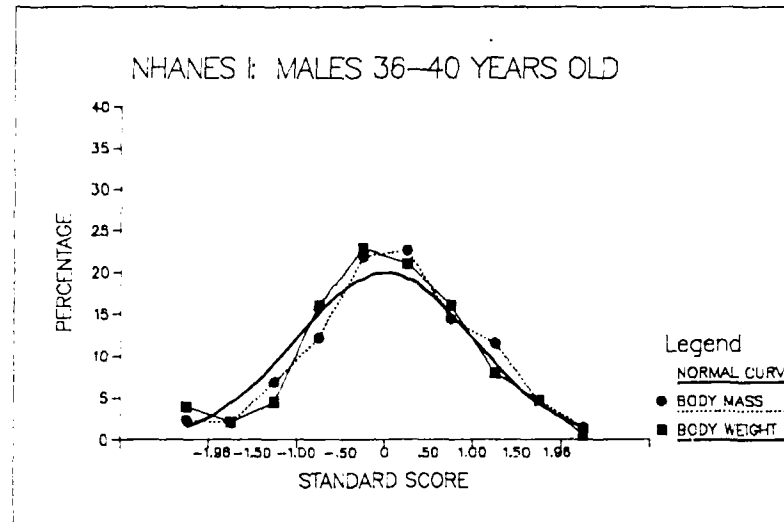
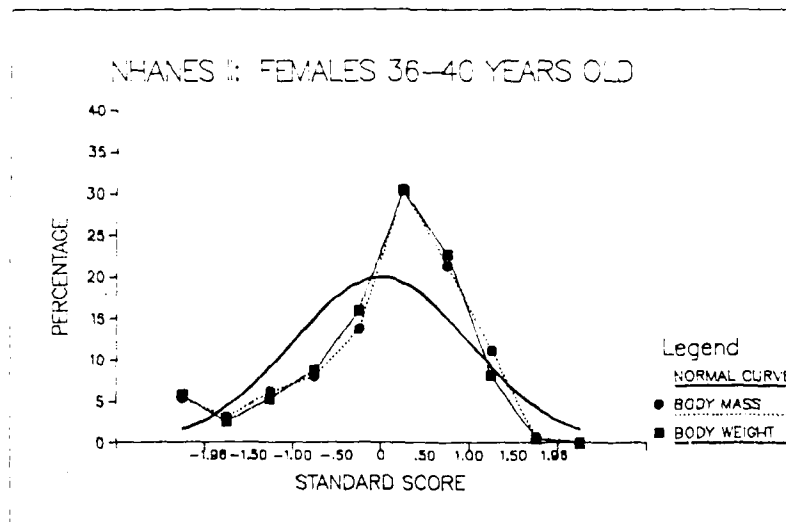
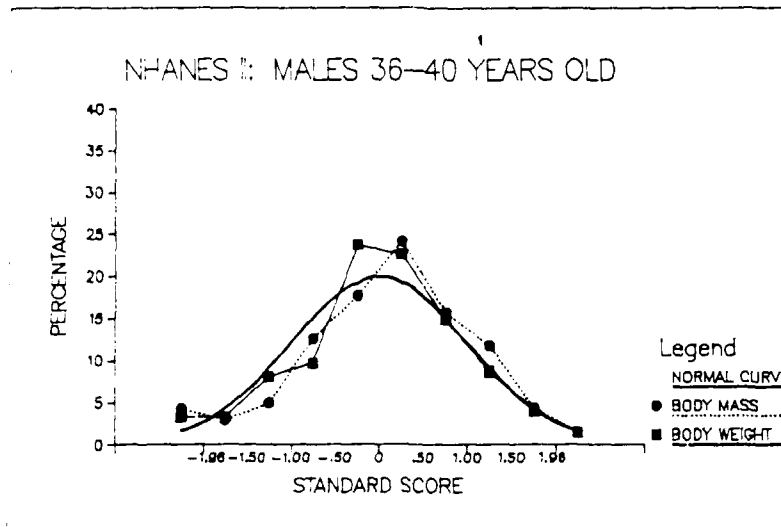


Figure A-12

Comparison of the Distribution of Body Weight and Body-Mass
Standard Scores to the Standard Normal Distribution

NHANES II Survey Males and Females
36-40 Years Old



results of the Chi-square tests reported above.

Tables A-5 and A-6 were prepared to directly assess the effect on the rates of disqualification for overweightedness resulting from the differences between the actual distribution of body-mass standard scores and the standard normal distribution at the right tail of these distributions. These tables present the measured mean body-mass (Column 1) and standard deviation (Column 2) for the NLS, NHANES I and NHANES II participants; the maximum allowable weight standards at 120 percent and 135 percent of mean body-mass (Columns 3 and 4) as specified in this report and converted to standard scores (Columns 5 and 6); the percentage of participants whose body-mass standard score exceeded the maximum allowable standard score under the standard normal distribution (Columns 7 and 8) and under the actual distribution of standard scores (Columns 9 and 10) in the data sets at 120 percent and 135 percent of mean body-mass; and the percentages of participants disqualified for overweightedness under the proposed revised maximum weight standards presented in this report (Columns 11 and 12). Table A-5 presents the data for males and Table A-6 presents the data for females.

For both males and females, a smaller percentage of the participants would be disqualified for overweightedness under the actual distribution of body-mass standard scores (Columns 9 and 10) compared to the percentage expected under the standard normal distribution (Columns 7 and 8), a result which was visually presented in Figures A-1 through A-12. In other words, the percentage of participants with actual standard scores above the maximum body-mass standard score is lower than would be obtained if

Table A-5

Comparison of Percentages of NLS, NHANES I, and NHANES II Participants Disqualified for Overweightness under the Standard Normal Distribution, the Actual Distribution of Standard Scores, and the Proposed Revised AR 40-501 Maximum Weight Standards

Males

Column Number	Body Mass		Maximum Weight Standard				Percent with Standard Scores above Maximum				Percent Disqualified	
	Body Mass		Body Mass		Standard Score		Normal Distribution		Actual Distribution		Percent Disqualified	
	Mean	Std. Dev.	120%	135%	120%	135%	120%	135%	120%	135%	120%	135%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
NLS												
16-20 Years-old	22.8	3.3	28	31	1.58	2.48	5.7	.7	1.9	.1	5.2	1.9
21-24 Years-old	23.9	3.3	29	32	1.55	2.45	6.1	.7	1.3	.0	6.6	2.2
NHANES I												
16-20 Years-old	22.5	3.6	28	31	1.53	2.36	6.3	.9	.5	.0	7.8	2.4
21-24 Years-old	24.0	3.6	29	32	1.39	2.22	8.2	1.3	4.6	.0	7.8	2.8
25-30 Years-old	24.9	4.2	30	34	1.21	2.17	11.3	1.5	5.9	.0	8.6	4.1
31-35 Years-old	25.5	4.0	31	35	1.38	2.38	8.4	.9	5.6	.9	8.0	4.6
36-40 Years-old	26.2	4.1	31	35	1.17	2.15	12.1	1.6	11.0	.4	6.3	1.1
NHANES II												
16-20 Years-old	22.8	3.9	28	31	1.33	2.10	9.2	1.8	1.9	.0	6.1	3.0
21-24 Years-old	24.0	3.8	29	32	1.32	2.11	9.3	1.7	6.1	.2	8.0	2.7
25-30 Years-old	25.2	4.5	30	34	1.07	1.96	14.2	2.5	9.2	.0	7.6	3.2
31-35 Years-old	26.2	4.0	31	35	1.20	2.20	11.5	1.4	7.8	.0	7.5	2.2
36-40 Years-old	26.1	4.0	31	35	1.23	2.23	10.9	1.3	11.5	.1	9.7	2.4

Table A-6

Comparison of Percentages of NLS, NHANES I, and NHANES II Participants Disqualified for Overweightness under the Standard Normal Distribution, the Actual Distribution of Standard Scores, and the Proposed Revised AR 40-501 Maximum Weight Standards

Females

Column Number	Body Mass		Maximum Weight Standard				Percent with Standard Scores above Maximum				Percent Disqualified	
	Body Mass		Body Mass		Standard Score		Normal Distribution		Actual Distribution		Percent Disqualified	
	Mean	Std. Dev.	120%	135%	120%	135%	120%	135%	120%	135%	120%	135%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
NLS												
16-20 Years-old	27.6	4.6	34	38	1.39	2.26	8.2	1.2	1.9	.0	6.5	2.6
21-24 Years-old	28.4	4.8	35	39	1.38	2.21	8.4	1.4	.9	.1	8.6	4.1
NHANES I												
16-20 Years-old	28.5	5.1	34	38	1.08	1.86	14.1	.1	4.0	.0	9.7	5.1
21-24 Years-old	29.2	5.9	35	39	.98	1.66	16.4	4.9	5.5	.1	10.5	5.9
25-30 Years-old	30.4	7.0	36	41	.80	1.51	21.2	6.6	15.2	.7	14.0	6.3
31-35 Years-old	31.8	7.6	37	42	.68	1.34	24.8	9.0	24.9	.1	14.7	8.1
36-40 Years-old	32.4	7.3	38	43	.77	1.45	22.1	7.4	19.1	.4	16.6	7.8
NHANES II												
16-20 Years-old	28.1	5.9	34	38	1.00	1.68	15.9	4.7	9.3	.1	9.9	4.8
21-24 Years-old	29.2	6.4	35	39	.91	1.53	18.1	6.3	7.8	.3	12.2	5.8
25-30 Years-old	30.0	6.6	36	41	.91	1.67	18.1	4.8	12.6	.0	15.4	7.1
31-35 Years-old	31.1	7.4	37	42	.80	1.47	21.2	7.1	14.7	.2	18.5	10.5
36-40 Years-old	32.3	7.6	38	43	.75	1.41	22.7	7.9	17.0	1.5	16.5	8.5

the distribution of standard scores perfectly matched the standard normal distribution. This result indicates that maximum weight standards, expressed as a percentile of the actual standard scores found in the data sets, are more inclusionary than they would be if the maximum weight standards were set using a percentile score based on the normal distribution.

For both males and females, the percentage disqualified for overweightedness under the 120 percent of mean body-mass maximum weight standards, as calculated in Section X of this report (Column 11), is lower than that which would be observed if the standard scores were normally distributed around the actual mean (Column 7). When the percentage disqualified under the 120 percent maximum weight standard (Column 11) is compared to the percentage with standard scores above the maximum weight standard (Column 9), we find that for males two-thirds of the percentages are higher and one-third are lower, while for females the percentages are generally lower.

Similar comparisons for males and females under the 135 percent of body-mass maximum weight standards reveals that the percentage disqualified for overweightedness under the standards calculated in Section VI of this report (Column 12), is consistently higher than would be obtained if the standard scores were normally distributed around the actual mean (Column 8). In contrast to the mixed results observed when the actual disqualification rate under the 120 percent standard (Column 11) was compared to the actual distribution of standard scores (Column 9), the comparisons for the 135 percent of mean body-mass standards (Column 12

versus Column 10) show that the actual disqualification rate is higher than would be obtained if percentile standard scores based on the actual distribution of standard scores were applied.

The net result of these comparisons is that if body-mass were indeed normally distributed, then the 120 percent of mean body-mass maximum weight standard results in the acceptance of some percentage who ought to be disqualified. In contrast, the 135 percent of body-mass maximum weight standard excludes some percentage who ought to be qualified. A maximum allowable weight standard based on the actual distribution of standard scores, regardless of the specified percentage of body-mass employed, results in the acceptance of some percentage who would be disqualified if the maximum standard was based on the standard normal distribution.

Oddly, the ostensibly more restrictive 120 percent of mean body-mass maximum weight standard (Column 11) is, compared to the normally distributed maximum weight standard (Column 7), more liberal, as measured by the percentage disqualified, than the ostensibly less restrictive 135 percent of mean body-mass maximum weight standard (Column 12) in that a larger percentage is disqualified than would be expected under a normal distribution (Column 8). However, such an interpretation relies on the assumption that body weight and body-mass are normally distributed.

In the analysis and determination of maximum weight standards the critical portion of the distribution of body weights and body-mass standard scores to be considered is the right tail. As has been shown, the actual distribution of values in this area of the distribution is

consistently lower than what would result if body weights and body-mass standard scores perfectly fit the standard normal distribution. The results of the analysis presented above suggest that the use of either the normal distribution or the actual distribution of standard scores, based on the assumption of normalcy, is not particularly the better or more appropriate methodology to employ in the determination of maximum allowable weight standards.

The comparison of the actual distribution of body weight standards scores to the standard normal distribution presented above implicitly suggests that body weight ought to be normally distributed and deviations from normalcy are a reason for concern. However, the data suggest that indeed body weight is not normally distributed or, if it is, the data sets employed in the analysis contain some bias resulting in a lack of normalcy in its distribution. We are satisfied, based on the consistency of the results presented in the body of this report and in the first portion of this Appendix that the second possibility, that the data sets contain bias, is not the case. Accordingly, the first possibility, that body weight is not normally distributed, is in fact nearer the truth.

The notion that all variables occurring in the natural world are, or ought to be, normally distributed should not be confused with the need for, or the assumption of, normalcy in the application of statistical tests. In contrast to some variables, such as Intelligence Quotients, which are free to vary between some infinitely low and some infinitely high value, body weight is limited in the values it may assume. When height and body build are controlled, there are biological constraints

governing the lower and upper limits of body weight. Thus, the observed variations in body weight and body-mass from the standard normal distribution in the three data sets (see Figures A-1 through A-12) are not variations from "normalcy" at all, as defined by nature or biology; they are only variations from the ideal of statistical normalcy. While this may preclude the proper application of some parametric tests of statistical significance, it does not preclude the establishment of maximum weight standards based on a specified percentage of body-mass as has been proposed in this report.

The Body-Mass Index

In Section IV of this report is a brief description of the body-mass index as a quantitative method for the simultaneous analysis of height and body weight. In that description, reference was made to an analysis of NHANES I data (National Center for Health Statistics, 1983) indicating that a variation of the formula which raised height to the 1.5 power ($BM=W/H^{1.5}$) was more accurate in estimating the weight of women than was the formula applied to males in which height was raised to the 2 power ($BM=W/H^2$). Reproduced below are pages 71 through 75 of the referenced report which describes in detail the mathematical derivation of the body-mass index formula and presents data comparing the effect on females of the $BM=W/H^{1.5}$ variation of the formula compared to the $BM=W/H^2$ variation.

Weight-height index

The weight-height index (W/H^p) used as a measure of overweight in this report was obtained by a method suggested by Behnke³³. Assuming the existence of a linear relationship of weight W on height H of the form

$$W = W_0 + b(H - H_0) \quad (8)$$

where W_0 and H_0 represent some central locations of weight and height and b is the slope of the regression line. Behnke³³ was able to show that W/H^p could be calculated as

$$W/H^p = \frac{W_0}{H_0^p} + \frac{b}{H_0^{p-1}} \quad (9)$$

In applying Behnke's method to NHANES I data, equations of the form postulated were derived for age groups 20-24, 25-34, 35-44, 45-54, 55-64, 65-74, and 20-29 years. H_0 was interpreted as the mid-range of height values, and W_0 was interpreted as the average weight for height H_0 . Table VII shows the mid-range of height H_0 , mean weight for height H_0 , regression coefficient b of weight on height, and calculated p for each sex/age subgroup.

The power value of $p = 2$ was selected as a standard for men based on ages 20-29 years, and the power value of $p = 1.5$ was selected as a standard for women

based on ages 20-29 years.

The weight-height index described above was validated in the following manner. For a given height H in a given age and sex subgroup, a predicted weight W' was calculated using the formula developed by Behnke³³

$$W' = H^p A$$

where

$$A = \frac{W_0}{H_0^p} \quad (9)$$

H_0 is the mid-range of values of height for a given sex and age group, and W_0 is the average weight at height H_0 . For each sex, age, and height group, the weight determined from the regression equation of weight on height was compared with the weight obtained from equation (9). Table VIII shows the difference between these two values. With the exception of tallest men ages 45-54 and 65-74 years, the maximum difference between these two values is 2 pounds. A similar comparison also was made for women when $p = 2$. There were marked differences between the two values (table IX).

Table VII. Mid-range of height H_0 , mean weight at height H_0 , regression coefficient of weight on height, power of height, and nearest half integer for p , by sex and age, United States, 1971-74

Sex and age	Mid-range of height H_0 (inches)	Mean weight at height H_0 (in pounds)	Regression coefficient b	Power of height p	p rounded to the nearest 0.5 integer
Men					
20-24 years	66	160	4.441	1.89	2.0
25-34 years	66	170	4.941	1.98	2.0
35-44 years	66	174	5.277	2.06	2.0
45-54 years	66	173	4.454	1.75	1.5 or 2.0
55-64 years	66	173	5.064	1.99	2.0
65-74 years	66	169	4.355	1.76	1.5
20-29 years	66	163	4.697	1.96	2.0
Women					
20-24 years	62.5	130.5	3.197	1.53	1.5
25-34 years	62.5	137.5	3.587	1.63	1.5
35-44 years	62.5	140	2.815	1.63	1.5
45-54 years	62.5	146.5	3.857	1.51	1.5
55-64 years	62.5	151.5	3.492	1.44	1.5
65-74 years	62.5	149	3.583	1.50	1.5
20-29 years	62.5	132	3.167	1.62	1.5

Table VIII. Calculated mean weight¹ from mean group weight relative to mean group height and mean weight² estimated from regression equation of weight on height by sex and age, United States, 1971-74

Sex and height	Calculated mean weight	Estimated mean weight	Excess 2 over 1	Calculated mean weight	Estimated mean weight	Excess 2 over 1	Calculated mean weight	Estimated mean weight	Excess 2 over 1	Calculated mean weight	Estimated mean weight	Excess 2 over 1
	1	2		1	2		1	2		1	2	
Weight in pounds												
Men	20-24 years			25-34 years			35-44 years			45-54 years		
62 inches	133	134	+1	141	141		145	143	-2	144	147	+3
63 inches	137	139	+2	146	145	-1	149	148	-1	148	152	+4
64 inches	142	143	+1	150	151	+1	154	151	-3	153	156	+3
65 inches	146	148	+2	155	156	+1	159	158	-1	158	160	+2
66 inches	151	152	+1	160	160		164	163	-1	163	164	+1
67 inches	155	157	+2	165	165		169	168	-1	168	169	+1
68 inches	160	160		170	170		174	174		173	173	
69 inches	165	164	-1	175	174	-1	179	179		178	177	-1
70 inches	170	169	-1	180	179	-1	184	184		183	182	-1
71 inches	174	174		185	184	-1	189	190	+1	189	187	-2
72 inches	179	178	-1	190	189	-1	195	194	-1	194	191	-3
73 inches	184	183	-1	195	194	-1	200	200		199	198	-1
74 inches	189	187	-2	200	199	-1	205	204	-1	205	200	-5
Women												
57 inches	114	112	-2	120	118	-2	127	125	-2	129	129	
58 inches	117	116	-1	123	121	-2	130	129	-1	131	133	+2
59 inches	120	120		126	126		134	133	-1	136	136	
60 inches	123	123		129	128	-1	137	137		140	140	
61 inches	126	126		133	132	-1	141	141		143	143	
62 inches	129	129		136	135	-1	144	144		147	147	
63 inches	132	132		139	139		148	148		150	150	
64 inches	135	135		142	141	-1	151	151		154	154	
65 inches	138	138		145	145		155	156	+1	157	158	+1
66 inches	141	142	+1	149	150	+1	159	159		161	161	
67 inches	144	145	+1	152	153	+1	162	163	+1	165	164	-1
68 inches	148	148		156	157	+1	166	167	+1	169	168	-1
Men	55-64 years			65-74 years			70-79 years					
62 inches	144	143	-1	141	141		136	136				
63 inches	148	147	-1	145	145		140	140				
64 inches	152	151	-1	149	149		144	145	+1			
65 inches	156	156		154	156	+2	149	150	+1			
66 inches	160	160		159	161	+2	154	155	+1			
67 inches	164	164		164	164		159	159				
68 inches	168	168		169	169		163	163				
69 inches	172	172		174	174		168	168				
70 inches	176	176		179	179		173	173				
71 inches	180	180		184	182	-2	178	178				
72 inches	184	183	-1	189	186	-3	183	182	-1			
73 inches	189	187	-2	194	190	-4	188	187	-1			
74 inches	205	203	-2	200	194	-6	193	192	-1			
Women												
57 inches	132	132		130	130		115	113	-2			
58 inches	135	136	+1	133	134	+1	118	117	-1			
59 inches	139	140	+1	137	137		121	120	-1			
60 inches	142	143	+1	140	140		124	123	-1			
61 inches	146	147	+1	144	144		127	127				
62 inches	150	150		147	147		130	130				
63 inches	153	153		151	151		134	134				
64 inches	157	157		154	154		137	137				
65 inches	161	160	-1	158	158		140	140				
66 inches	164	164		162	161	-1	143	144	+1			
67 inches	168	167	-1	165	165		146	147	+1			
68 inches	172	171	-1	169	169		150	151	+1			

¹ Mean weight calculated from Weight (in pounds) = $k \cdot \text{height}^2$, where $k = 2$ for men and $k = 1.5$ for women. k , constant, derived from mean group weight relative to mean group height.

² Estimated from regression equations of weight on height, x , for specified age groups.

Table IX. Calculated mean weight¹ from group weight relative to mean group height and mean weight² estimated from regression equation of weight on height, by sex and age for women: United States, 1971-74

Sex and height	Calculated mean weight	Estimated mean weight	Excess 2 over 1	Calculated mean weight	Estimated mean weight	Excess 2 over 1	Calculated mean weight	Estimated mean weight	Excess 2 over 1	Calculated mean weight	Estimated mean weight	Excess 2 over 1
	1	2		1	2		1	2		1	2	
Weight in pounds												
Women	20-24 years			25-34 years			35-44 years			45-54 years		
57 inches	109	112	+3	114	116	+4	121	125	+4	124	129	+5
58 inches	112	116	+4	118	121	+3	126	129	+3	128	133	+5
59 inches	116	120	+4	123	125	+2	130	133	+3	132	136	+4
60 inches	120	123	+3	127	128	+1	135	137	+2	137	140	+3
61 inches	124	126	+2	131	132	+1	139	141	+2	141	143	+2
62 inches	128	129	+1	135	136	+1	144	144	-	146	147	+1
63 inches	133	132	-1	140	139	-1	148	148	-	151	150	-1
64 inches	137	135	-2	144	142	-2	153	152	-1	156	154	-2
65 inches	141	138	-3	149	146	-3	158	156	-2	161	158	-3
66 inches	146	142	-4	153	150	-3	163	159	-4	166	161	-5
67 inches	150	145	-5	158	153	-5	168	163	-5	171	165	-6
68 inches	154	148	-6	163	157	-6	173	167	-6	176	168	-8
Women	55-64 years			65-74 years			20-29 years					
57 inches	126	132	+6	124	130	+6	110	113	+3			
58 inches	130	136	+6	128	134	+6	114	117	+3			
59 inches	135	140	+5	133	137	+4	118	120	+2			
60 inches	140	143	+3	137	140	+3	122	123	+1			
61 inches	144	147	+3	142	144	+2	126	127	+1			
62 inches	149	151	+2	147	147	-	130	130	-			
63 inches	154	153	-1	151	151	-	134	134	-			
64 inches	159	157	-2	156	154	-2	138	137	-1			
65 inches	164	160	-4	161	158	-3	143	140	-3			
66 inches	169	164	-5	166	161	-5	148	144	-4			
67 inches	174	167	-7	171	165	-6	152	147	-5			
68 inches	179	171	-8	176	169	-7	156	151	-5			

¹ Mean weight calculated from weight in pounds = $K \times \text{height}^2$, where $p = 2$ for women. K (constant) derived from mean group weight relative to mean group height.
² Estimated from regression equations of weight on height for specified age groups.

DATA
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